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200-UP-1 Vertical Profiling Activity Summary Report

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Richland, Washington

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1.0 INTRODUCTION

This report summarizes and interprets hydrochemical results collected in support of the 200-UP-1 Groundwater Operable Unit Contaminant Vertical Profiling Activity. Details of the investigation are contained in the *Description of Work for the 200-UP-1 Groundwater Contaminant Vertical Profiling Activity* (WHC 1993) and the *Description of Work for Characterization of 200-UP-1 Monitoring Wells* (WHC 1994). The general investigation strategy is presented in the *Remedial Investigation/Feasibility Study Work Plan for the 200-UP-1 Groundwater Operable Unit, Hanford Site, Richland, Washington* (DOE-RL 1992). The data and interpretations presented in this report will be used to support characterization and remedial decisions for the 200-UP-1 operable unit.

2.0 METHODOLOGY

2.1 INTRODUCTION

Two primary contaminants of concern (uranium and technetium-99 [^{99}Tc]) and two secondary contaminants (nitrate and carbon tetrachloride) are present in the groundwater along the southeastern edge of the 200 West Area. These contaminants are the subject of 200-UP-1 operable unit investigation activities. Contaminant distribution maps are shown in Figures 1 through 4. Potential source units for uranium, ^{99}Tc, and nitrate within the mapped area are the 216-U-1 and 216-U-2 cribs, the 216-U-8 crib, and the 216-U-12 crib (DOE 1993). The 216-U-16 crib is important in that effluent disposal to it provided hydraulic driving force for the movement of contaminants to groundwater beneath the 216-U-1 and 216-U-2 cribs. Discussions of the distribution of the uranium, ^{99}Tc, and nitrate within the mapped area are contained in Delegard et al. (1986), Ford (1993), Johnson (1993), and DOE (1994). A conceptual model of carbon tetrachloride distribution is discussed in Rohay et al. (1994).

Two phases of vertical characterization work were conducted in support of the 200-UP-1 operable unit investigation. The initial phase sampled groundwater from existing boreholes that had been completed and perforated or screened over intervals that extended from the water table to depths greater than 30 ft into the aquifer. Phase II groundwater sampling was conducted as a drill and test evaluation during the construction of a three-well cluster site. A well location map for the test wells is presented in Figure 5. Analytical methodologies are contained in Appendix A.

2.2 PHASE I METHODOLOGY

Five wells in the 200-UP-1 operable unit were proposed for multilevel testing to assess the vertical extent of groundwater contamination. Well testing consisted of pretest well suitability assessments and maintenance, tracer preparation and injection, straddle packer placement and zone testing, onsite evaluation of packer seal integrity (using tracer recovery results), and field- and offsite-laboratory sample analysis. A flow chart of vertical profiling activities is included in Figure 6.

Discrete zones were sampled using a straddle packer assembly to isolate 5-ft intervals within the screened/perforated intervals of a well (Figure 7). The packed-off interval was sampled using a

low-volume output, positive-displacement sampling pump. Purging rates were kept to less than 1 gal/min to enhance the potential for horizontal water movement from the aquifer adjacent to the packed-off interval rather than vertical movement along the casing annulus or bypassing the straddle packer assembly.

To assist in evaluating the potential for nonhorizontal movement and therefore mixing of nonrepresentative waste from outside the sample zone, a tracer was introduced into each well immediately before packing off and sampling discrete zones. Recovery of the tracer was monitored during the purge and sample interval for each zone. Tracer concentrations versus time were plotted to evaluate whether leakage around the packer or along the annulus of the well caused mixture of nonrepresentative water with water from the packed-off zone. Recovery curves are contained in Appendix B.

Testing was conducted from August 1993 through December 1993 in three of the five planned wells. Of the two wells in which testing was not completed, well 299-W19-8 was not accessible and well 299-W22-22 did not produce a sufficient volume of formation water from the test intervals for discharge to the surface. Two of the three wells in which testing was completed (wells 299-W19-18 and 699-38-70) are nearest to the axes of uranium and ^{99}Tc plumes. The third well (299-W19-4) is off-axis to the north and provides important control for contaminant distribution. Analytical results by well and sample interval are presented in Appendix C. Field- versus offsite-laboratory analysis are noted in the data sets.

2.3 PHASE II METHODOLOGY

Vertical profile testing at the three-well cluster site was conducted during Phase II from June 1994 to September 1994. Two wells (299-W19-29 and 299-W19-34A) were sampled after completion. Each well was tested using installed positive-displacement pumps operating at nominal purge rates of 2 to 3 gal/min. No special interval isolation was employed, but each well was purged until indicator parameters (dissolved oxygen, pH, specific conductance, and temperature) had stabilized before sampling.

Well 299-W19-34B was tested during drilling. At each test zone, the drive casing was backpulled from 2 to 10 ft to provide open hole for sampling. Sampling intervals were tested using one of two sampling assemblies. The upper three test zones utilized a packer/bladder pump assembly shown in Figure 8. This device is a low-volume sampling system that operated at purge rates generally less than 0.5 gal/min to enhance the potential for horizontal water movement from the formation adjacent to the sampling interval. The bladder pump was found to be ineffective at depths greater than 200 ft below the water table due to reduced pump efficiency, especially in the initial turbid water conditions at the start of purge in each zone.

For the lower three zones, a 3-hp variable-speed submersible pump was employed without any zone isolation devices (e.g., packers). The zones were initially pumped at a high rate to drawdown static water level and evacuate water primarily in the well bore. Indicator parameters mentioned above as well as turbidity were measured at a minimum of 30-min intervals to evaluate cleanup of the zone. When parameters had stabilized, the pump rate was reduced to as low as sustainable (1 to 3 gal/min) for sampling. The first zone in which this approach was used was immediately below the Ringold Unit A, the Ringold Lower Mud unit, and at a point where the casing was downsized. This casing size reduction provided a seal to vertical movement of water. Water chemistries in the deeper

interval are distinct enough to provide reasonable assurance that samples collected using this setup were representative of the zones being tested. Multiple low-transmissivity stratigraphic units (i.e., fine grained layers) occur beneath the Ringold Lower-Mud that are believed to have provided some sealing capacity along the drive casing. Analytical results by well and sample interval are presented in Appendix C. Field- versus offsite-laboratory analysis are noted in the data sets.

3.0 VERTICAL PROFILE TESTING RESULTS

Analytical results from all the wells and sample intervals are discussed together regardless of the phase or type of sampling. In general, it should be noted that the Phase II results are believed to be the most representative because the potential for packer/well bore bypass was minimized. All results are considered acceptable for evaluation of the presence of contamination.

Wells 299-W19-18, 699-38-70, and the cluster site wells 299-W19-29, 299-W19-34A, and 299-W19-34B had above background concentrations of each of the contaminants of concern. These wells lie close to the axis of the uranium and ^{99}Tc plumes. Presentation of analytical results are referenced to vertical section A-A' illustrated in Figure 9. The section runs west-to-east from the 216-U-1 and 216-U-2 cribs to well 699-38-70. The location of the section line is also presented relative to the carbon tetrachloride contamination in Figure 10. Only carbon tetrachloride was found to be present at elevated concentrations in well 299-W19-4. This well is projected into the section in the presentation of carbon tetrachloride results.

3.1 GENERAL PARAMETERS

General aquifer conditions are described in this section as evidenced by pH, specific conductance, dissolved oxygen, and redox results.

3.1.1 pH

Vertical profiling results of pH measurements at the time of sampling are illustrated in Figure 11. No distinct trends in pH are noted in any of the wells. All the results, with the exception of the 6.8 and 8.6 values at the cluster site, are within the normal range seen in Hanford groundwater due to calcium carbonate buffering of the system (Johnson 1993). The two extreme values at the cluster site may represent field errors in measurement.

3.1.2 Specific Conductance

All of the specific conductance results in Figure 12 have been temperature compensated and the reported units are micromhos/centimeter. Background specific conductance values have been reported to be 344 $\pm$83 (range=261 to 427) (Johnson 1993). Well 299-W19-18 has one value, the deeper zone, which is (465) outside the background range and is higher than the value in the shallower zone (396). At the cluster site, the only zone that exceeds background values is 840 at the water table. Both zones in well 699-38-70 exceed background with the possible indication of decreasing

conductance with depth. These samples were collected in August 1993. The 1,000 value noted at the top of the well is from a routine groundwater sampling event in December 1993 which is an integrated sample with the pump fixed at a single depth. It appears that conductivity is increasing with time in the well.

3.1.3 Dissolved Oxygen

Samples of dissolved oxygen content were collected and analyzed in the field only at the cluster well site (Figure 13). Oxygen-saturated water should be in the range of 8.5 to 8.8/L dissolved oxygen at this site (Drerer 1982). The two upper intervals appear to be at or near saturation. The third test zone below the water table at well 299-W19-34B contains much lower concentrations with essentially nondetectable concentrations from the fourth test zone down.

3.1.4 Redox Potential (eH)

As with the dissolved oxygen analysis, eH was measured only at the cluster well site (Figure 14). Measurements were restricted to the deeper test zones due to analytical equipment problems. The negative eH values indicate that the test intervals have the potential to be reducing. This appears to corroborate the dissolved oxygen results for the deep test zones.

3.2 CONTAMINANTS OF CONCERN

The distribution of the four contaminants of concern for this characterization activity are described individually in this section.

3.2.1 Uranium (Chemical)

The vertical distribution of uranium along the section line is very distinctive close to the 216-U-1 and 216-U-2 cribs versus at greater distances to the east (Figure 15). Concentrations in well 299-W19-18 appear to increase with depth. This pattern is reversed at the two other locations to the east. At the cluster well, the highest concentration is at the water table (353 ppb) with the concentration decreasing by nearly 50-fold at the 90-ft sampling point. Concentrations continue to decrease to total depth in the well. A slight decrease in concentration also can be seen in well 699-38-70 with depth, although the historical trend in concentration appears to be increasing.

3.2.2 Technetium-99

The distribution of ^{99}Tc in wells along the section line (Figure 16) is similar to uranium. An increase in concentration at depth in well 299-W19-18 was observed with the reverse trend in the wells to the east. Similarly, the decrease in concentration at the cluster well between sample points at the water table and at the 90-ft level is nearly 50-fold.

3.2.3 Nitrate

Nitrate is above regulatory standards (Drinking Water Standard=45,000 ppb) only in well 699-38-70 (730,400 ppb) along the section (Figure 17). It is nearly constant in concentration with depth, or slightly decreasing, in well 299-W19-18. The trend with depth at the cluster site is, however, distinctive. Decreasing concentration with depth, similar to that seen with uranium and ^{99}Tc, occurs in the upper 170 ft of the aquifer. The next two sample points (200 and 255 ft below the water table) reverse the trend and show elevated nitrate before concentrations drop to nondetectable levels at the deepest sample point (290 ft below the water table). The highest concentrations along the section occur in well 699-38-70 and appear to increase with depth.

3.2.4 Carbon Tetrachloride

Trends in carbon tetrachloride distribution with depth (Figure 18) are similar to nitrate distribution in wells 299-W19-18 and at the cluster well site. Concentrations above the drinking water standard (DWS) of 5 ppb occur in all wells and based on historical sampling of the upper unconfined aquifer appear to be increasing with time. An increase in concentration with depth occurs in well 299-W19-18. Likewise, a similar trend appears to occur in well 299-W19-4 which has been projected into the section just east of the cluster well site. At the cluster site a trend similar to that observed in nitrate, including the deeper occurrence of contamination, is repeated. Concentrations at well 699-38-70 are uniform with depth.

4.0 DISCUSSION

Three system controls are proposed that may explain concentration trends noted in the general parameters and contaminants of concern along the section line: dissolved oxygen/redox conditions within the aquifer, hydrostratigraphic influence, and preferential movement of contaminants along older, unsealed boreholes. Evidence of these three controls are presented in this section.

4.1 DISSOLVED OXYGEN/REDOX CONDITIONS IN THE AQUIFER

The transition with depth from oxygenated to reducing (redox) conditions in an aquifer provides a potential control on the mobility of redox-sensitive contaminants. Another way of stating this is that if redox-sensitive contaminants were injected uniformly throughout an aquifer, redox conditions would establish a lower bound to the zone in which the contaminants would be mobile. Dissolved oxygen and redox measurements at the cluster well site indicate a transition zone in the dissolved oxygen and redox conditions in the unconfined aquifer occurs between 100 to 130 feet BWT. The control that redox conditions exert on the distribution of contaminants of concern may be evidenced in the vertical distribution of uranium and technetium-99. Both uranium and technetium-99 are subject to chemical reduction (change in oxidation state) and immobilization in an oxygen-depleted environment.

Redox conditions do not operate independently of other system controls but simply as bounding conditions. Contaminant reduction and immobilization will only be operative if contaminants are injected or hydraulically transported to the transition zone. The only site at which samples were

collected below the transition zone is the cluster well site. Therefore, if contaminants are present at the other sample sites, they should be mobile and detected by sampling if present in sufficiently high concentrations. Two distinct patterns of detectable uranium/technetium contamination at depth, one in evidence at the cluster well site and the other at well 299-W19-18, are proposed as examples of how hydraulic controls, in combination with redox conditions, have resulted in differential contamination of the aquifer. This difference in contaminant transport into the aquifer has implications for remediation. At the cluster well site the highest levels of contamination are relatively shallow and a hydrostratigraphic control is proposed for contaminant distributions and discussed in section 4.2. Preferential hydraulic pathways which may be controlling the distribution of contaminants at well 299-W19-18 and deep carbon tetrachloride and nitrate contamination at the cluster well site are discussed in section 4.3.

4.2 HYDROSTRATIGRAPHIC CONTROL

Hydrostratigraphic controls on the vertical distribution of contaminants downgradient from the primary source units (216-U1,2 cribs) appears to restrict contaminant movement to the upper oxygenated portion of the unconfined aquifer in which contaminants are mobile. The distribution of contaminants at the cluster well site exemplifies this control. During drilling operations at the cluster well site, numerous fine grained, low hydraulic conductivity units were encountered which restricted the intervals which could be sampled. These units also restrict the vertical movement of contaminants. Vertical hydraulic conductivities can be orders of magnitude smaller than in the horizontal direction. This impediment to vertical movement may explain the relatively shallow distribution of not only uranium and technetium but the highest levels of nitrate and carbon tetrachloride contamination in the upper unconfined aquifer at the site. Deeper nitrate and carbon tetrachloride contamination at the site should only occur if there is a preferential hydraulic pathway that crosscuts the low conductivity stratigraphic units. Such pathways may exist around older, deep, unsealed wells, such as 299-W19-18.

4.3 PREFERENTIAL CONTAMINANT PATHWAYS

The deep distribution of all contaminants at 299-W19-18 and carbon tetrachloride at 299-W19-4, as well as deep carbon tetrachloride and nitrate at the cluster well site, argue for a mechanism which circumvents hydrostratigraphic controls in the upper unconfined aquifer. Older, unsealed deep wells appear to provide a likely pathway. The potential for movement of contaminants along unsealed wells has been proposed in other studies (Johnson 1993; Rohay 1994). Well 299-W19-18 is one of six older unsealed well adjacent to the U1/U2 cribs which may have provided pathways for contaminant movement deep in the aquifer. Also of interest in this report is the deep occurrence of carbon tetrachloride and nitrate at the cluster well site. Elevated carbon tetrachloride appears immediately above and below the Ringold lower mud confining unit while nitrate occurs immediately below the unit. The source for carbon tetrachloride is reported to be cribs associated with Z-plant which is more than 800 meters to the northwest of the U1 and U2 cribs. Between the Z-plant cribs and the cluster well site there are a few unsealed wells which should be investigated to attempt to corroborate the potential for deep contamination.

5.0 SUMMARY AND CONCLUSIONS

Hydrochemical data from vertical sampling of deep wells associated with the uranium and ^{99}Tc contaminant plumes in the 200-UP-1 operable unit were collected to characterize the vertical distribution of contaminants. Factors that are believed to control the vertical distribution of contaminants include redox conditions, hydrostratigraphic conditions which restrict vertical movement, and vertical cross-cutting preferential pathways such as unsealed wells. Based on interpreted redox conditions in the unconfined aquifer, a potential exists for mobile uranium and ^{99}Tc to be present at depths of up to 100 to 130 feet below the water table. Hydrostratigraphic controls appear to limit the vertical migration of these contaminants over the main body of the plume. Uranium and ^{99}Tc at concentrations greater than DWS in the main body of the contaminant plumes are interpreted to be present at depths of at least 30 to 50 ft below the water table. Carbon tetrachloride in the main part of the plume may exist at concentrations greater than DWS to slightly deeper zones. Nitrate is believed to have a similar distribution but is present above DWS in only well 699-38-70 in this report which was only sampled to approximately 30 ft below the water table.

Near the source facilities, contaminants may be present at deeper intervals along unsealed wells. Evidence for this distribution appears to be present in well 299-W19-18.

Of concern is the deep occurrence of carbon tetrachloride. It was detected at the Ringold lower mud confining unit, both above and below the unit. Further investigation and corroboration of this occurrence is recommended as well as corroboration of redox conditions in the upper unconfined aquifer.

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Figure 1. Uranium Distribution at the Water Table.

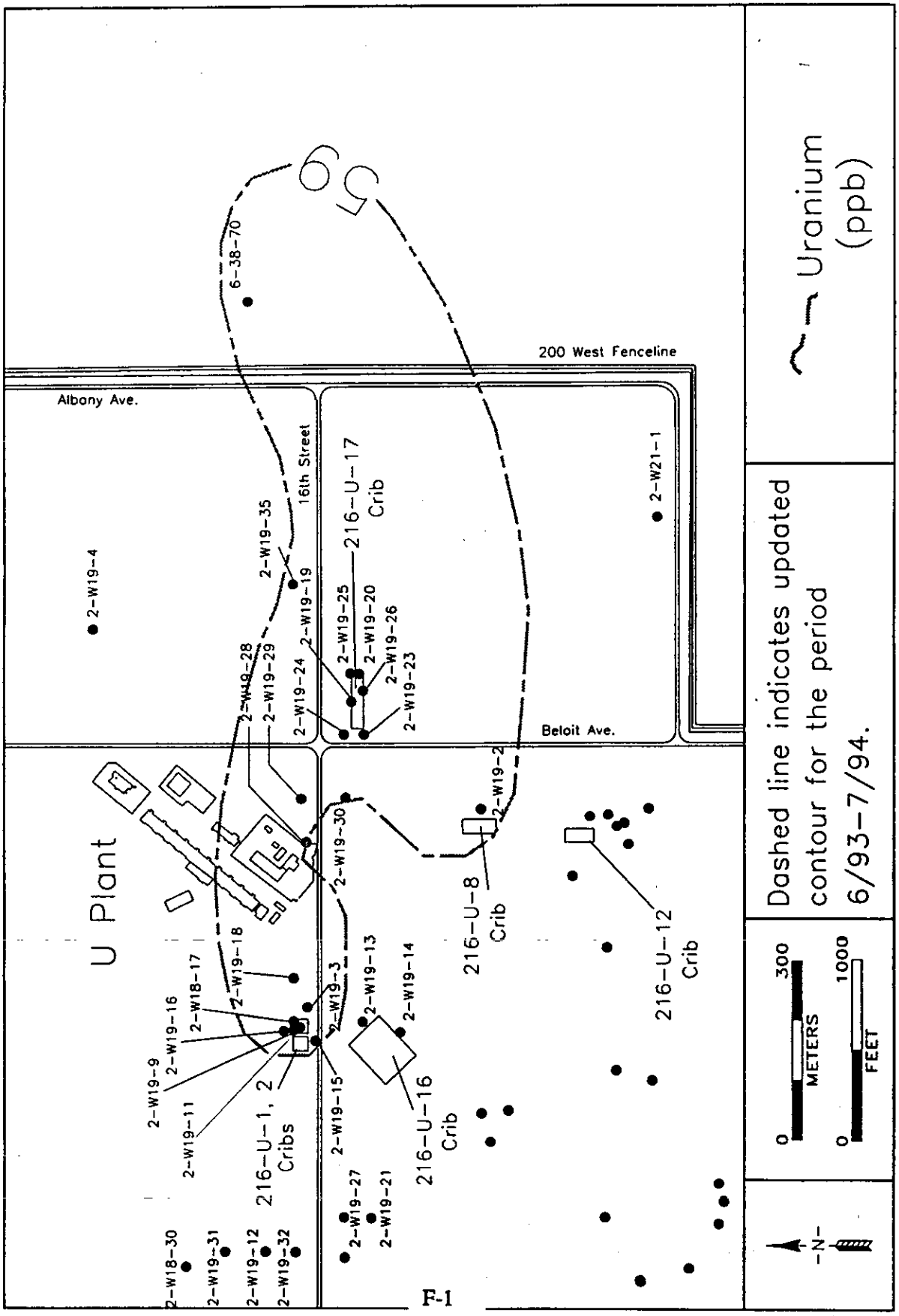


Figure 2. Technetium-99 Distribution at the Water Table.

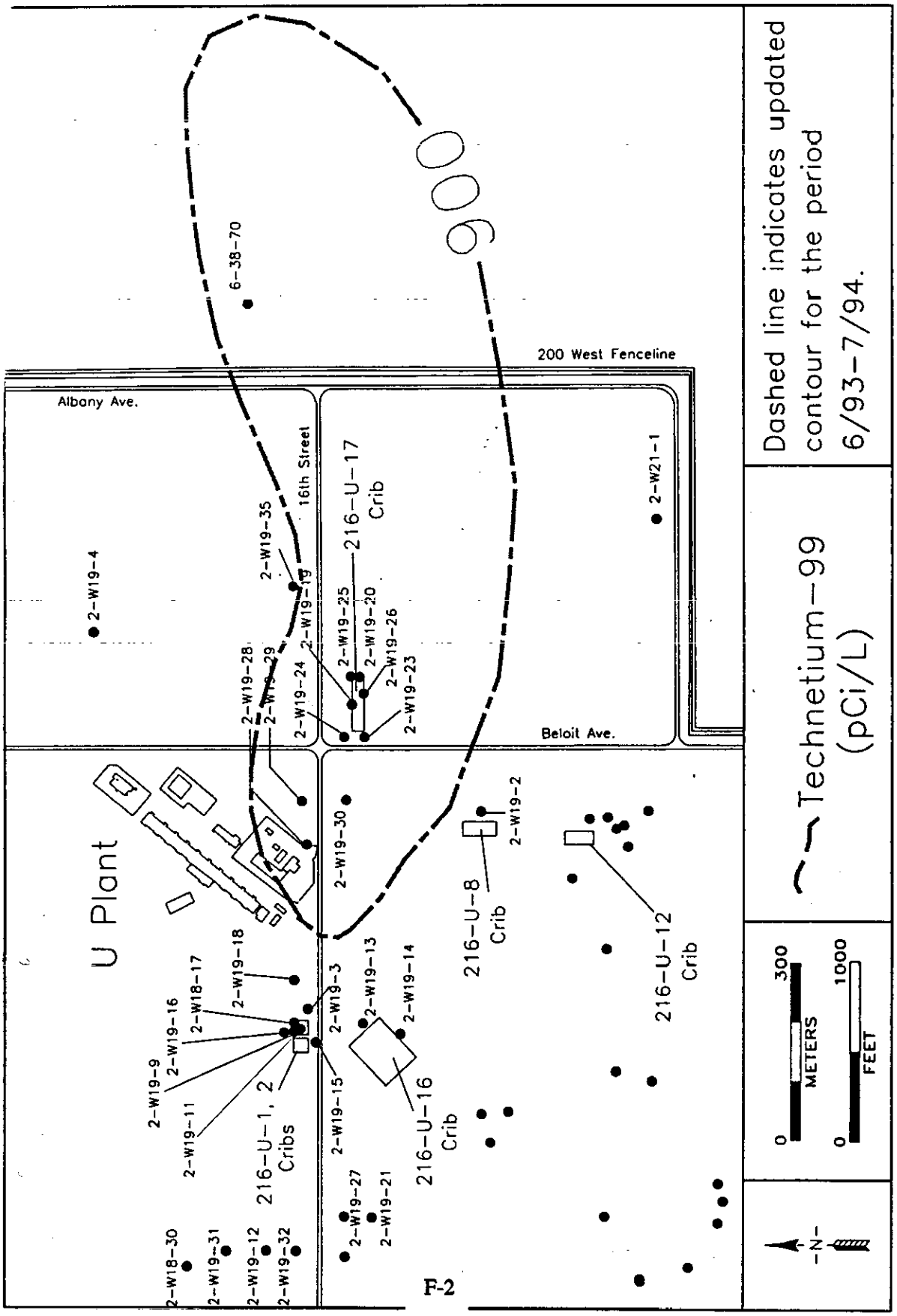


Figure 3. Carbon Tetrachloride Distribution at the Water Table.

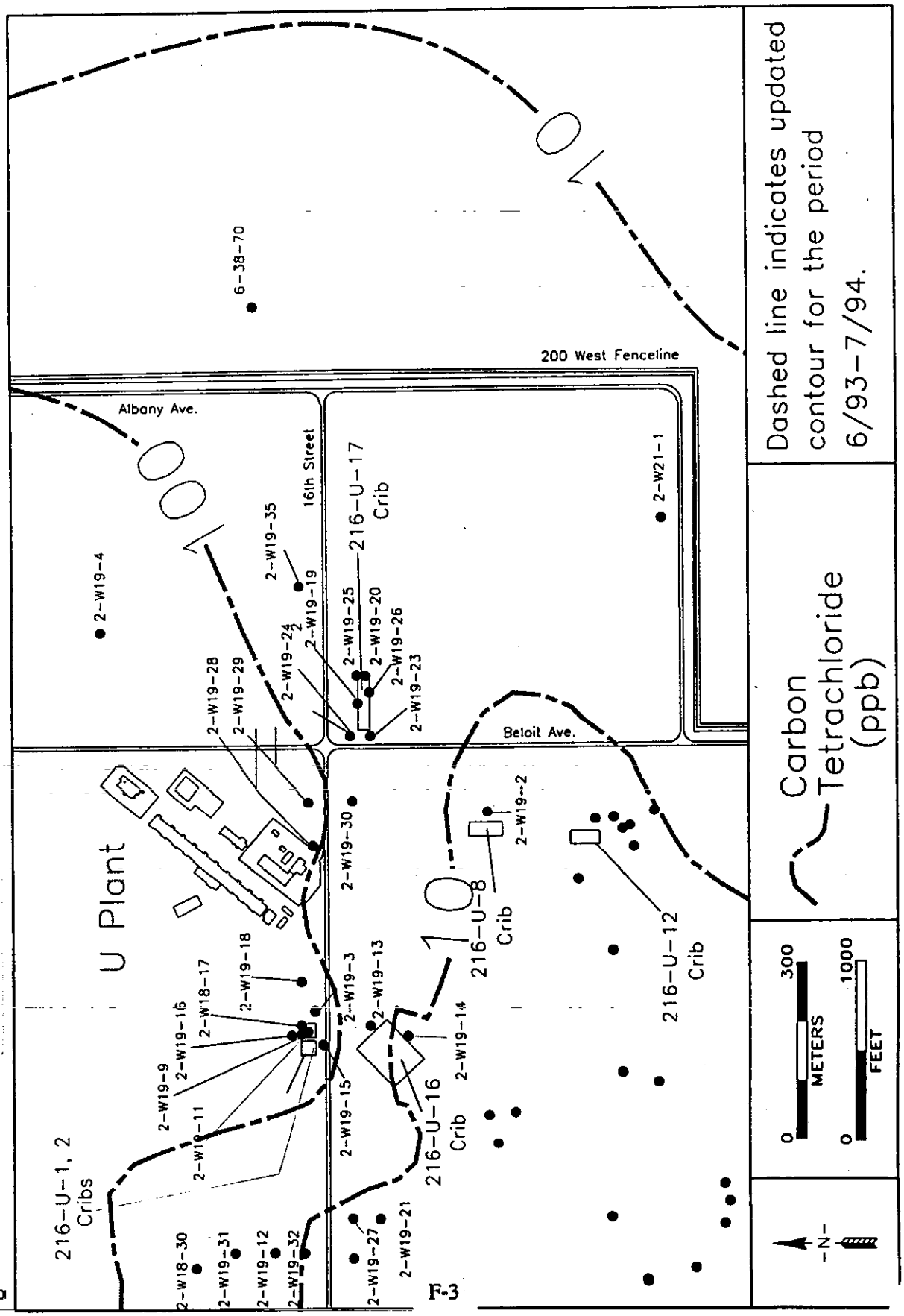


Figure 4. Nitrate Distribution at the Water Table.

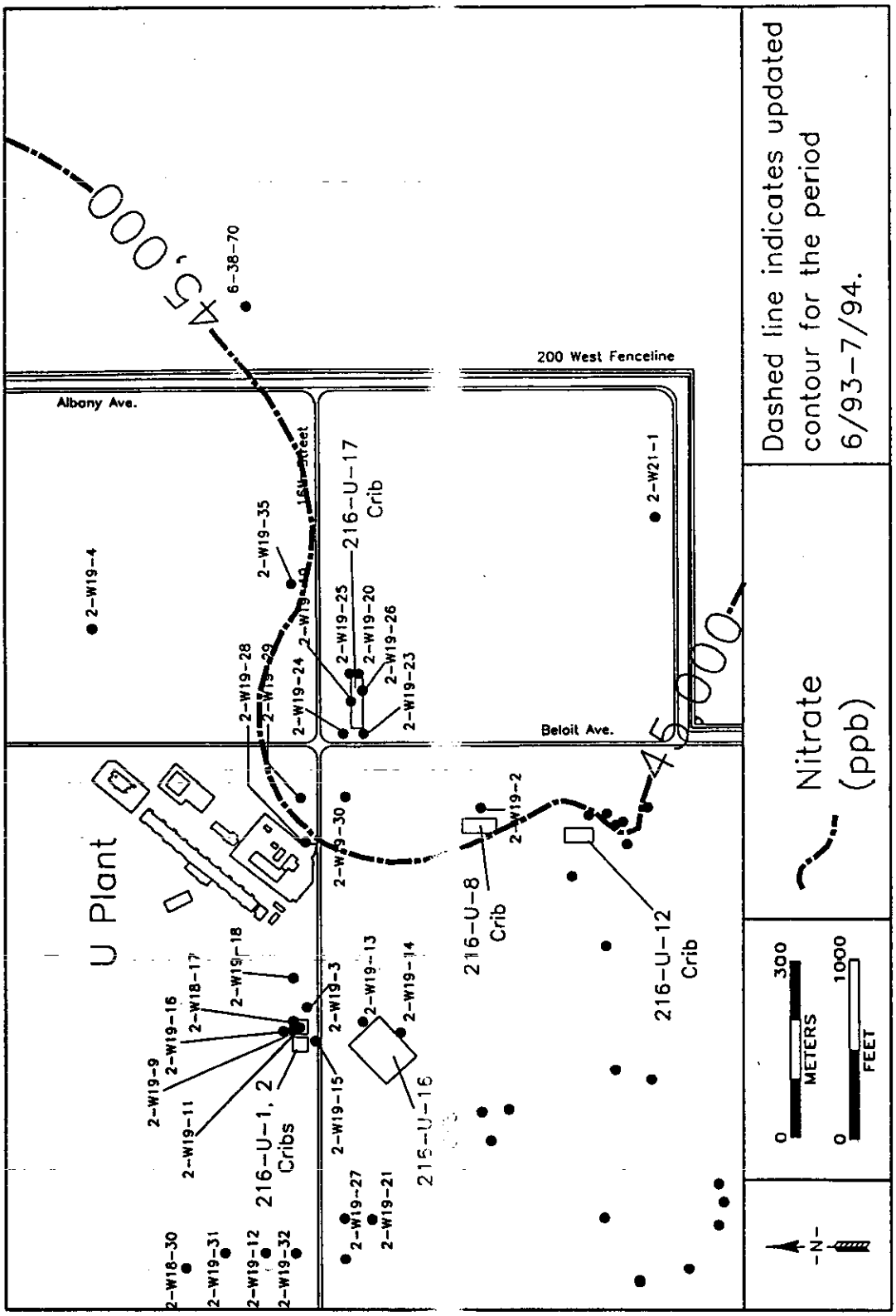


Figure 5. Vertical Profile Sampling Well Location Map.

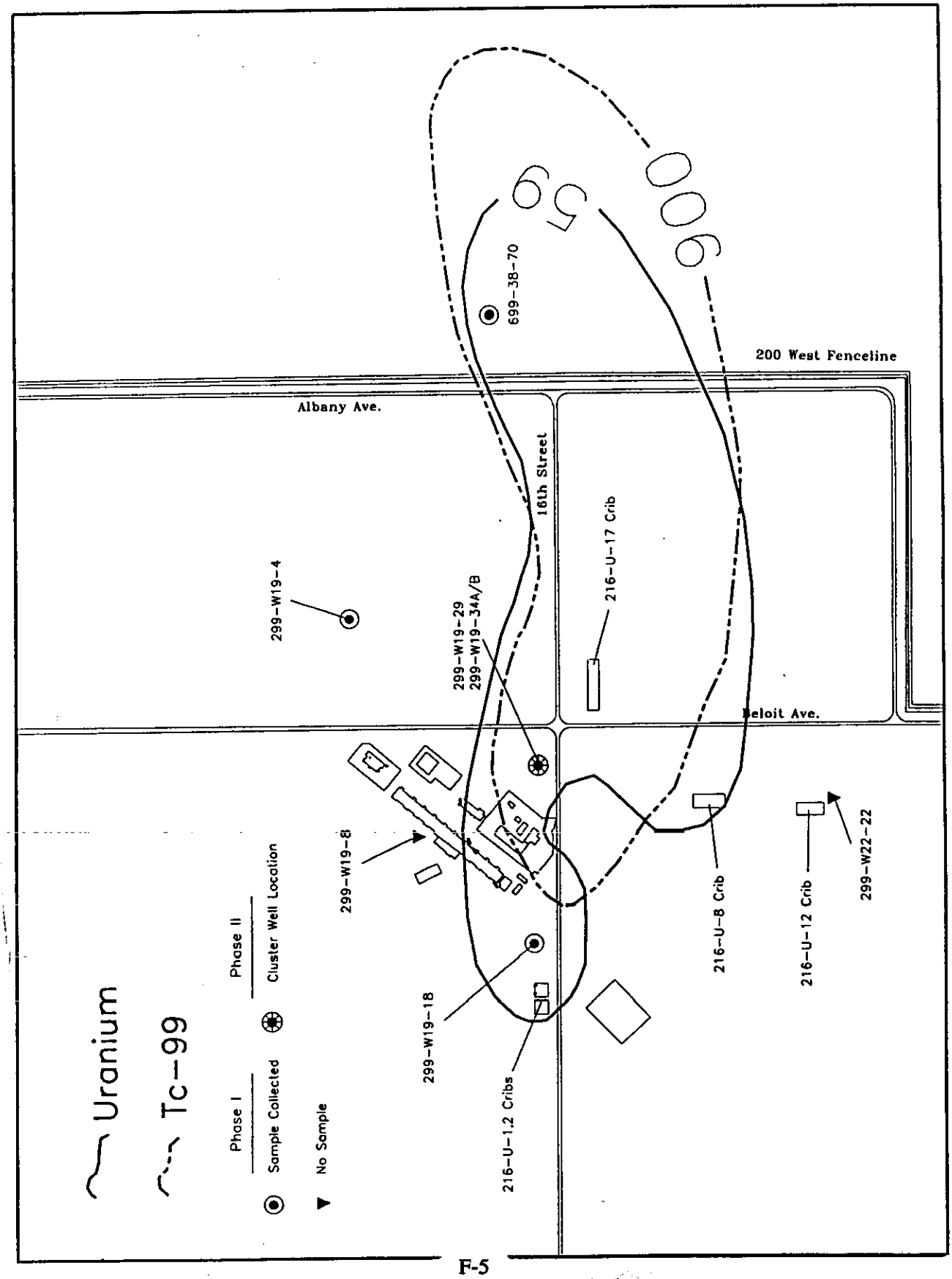


Figure 6. Sequence of Field Activities.

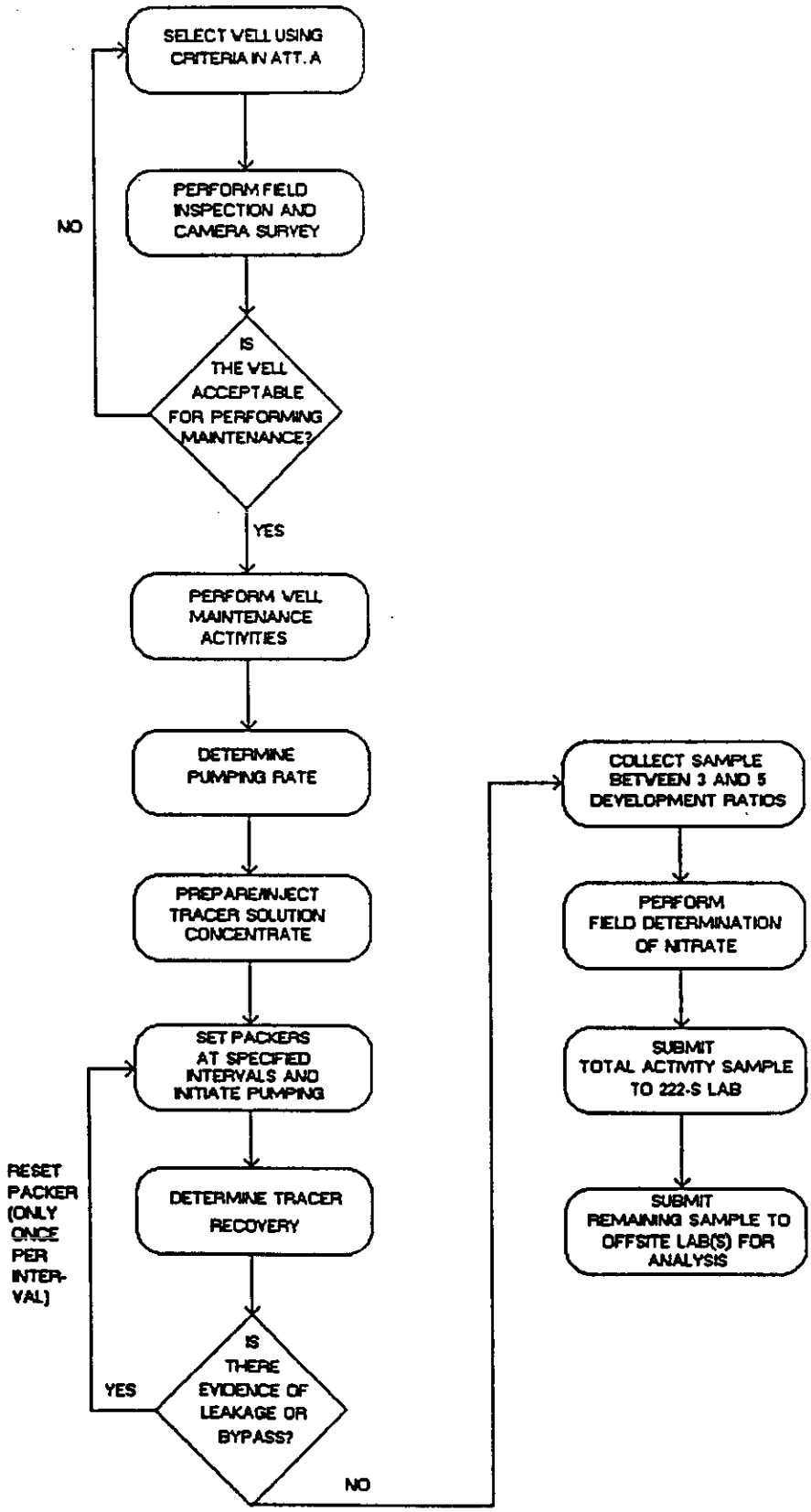


Figure 7. Phase I Straddle Peck Sampling Assembly.

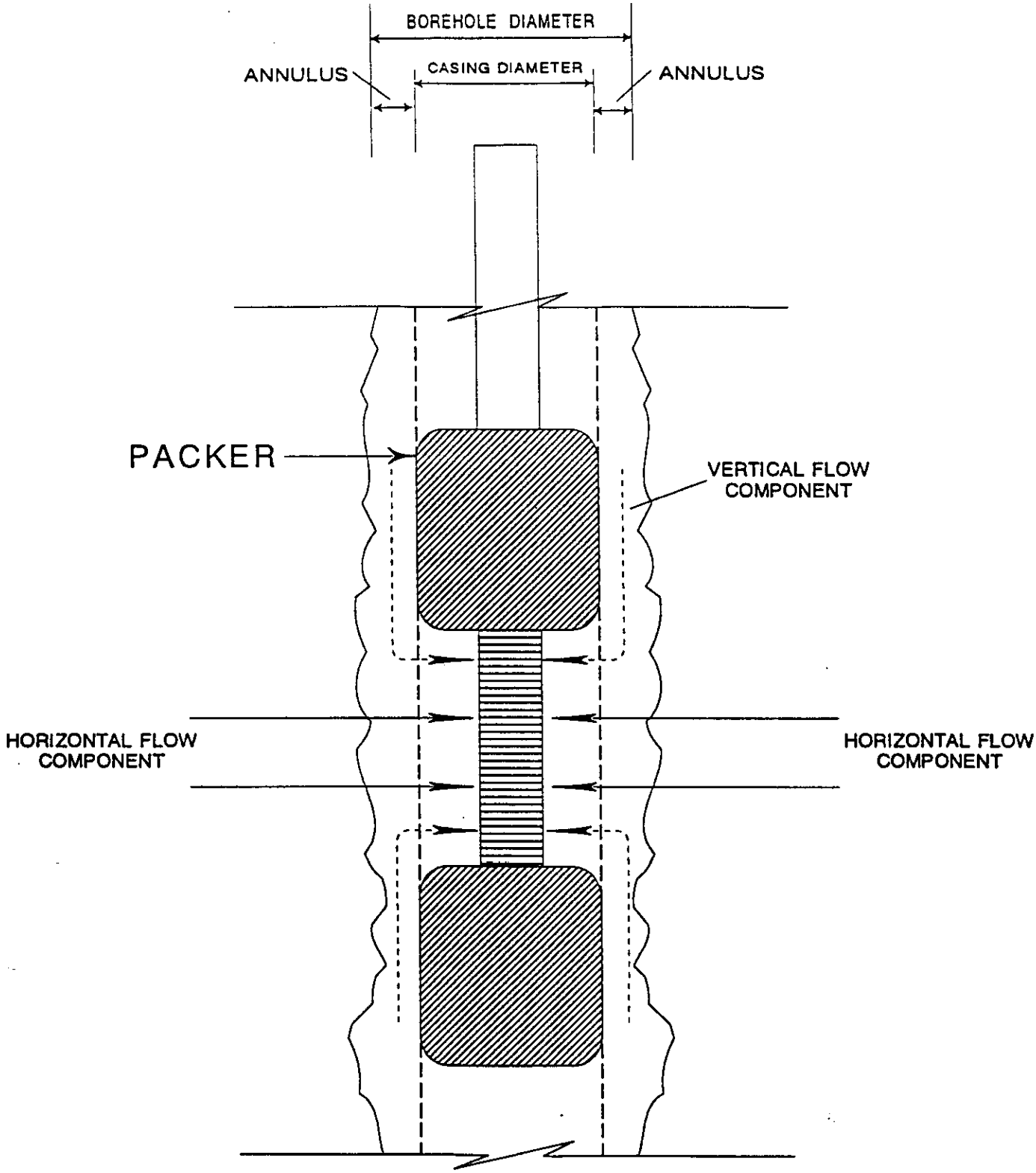


Figure 8. Phase II Packer/Bladder Pump Discrete Interval Testing Device.

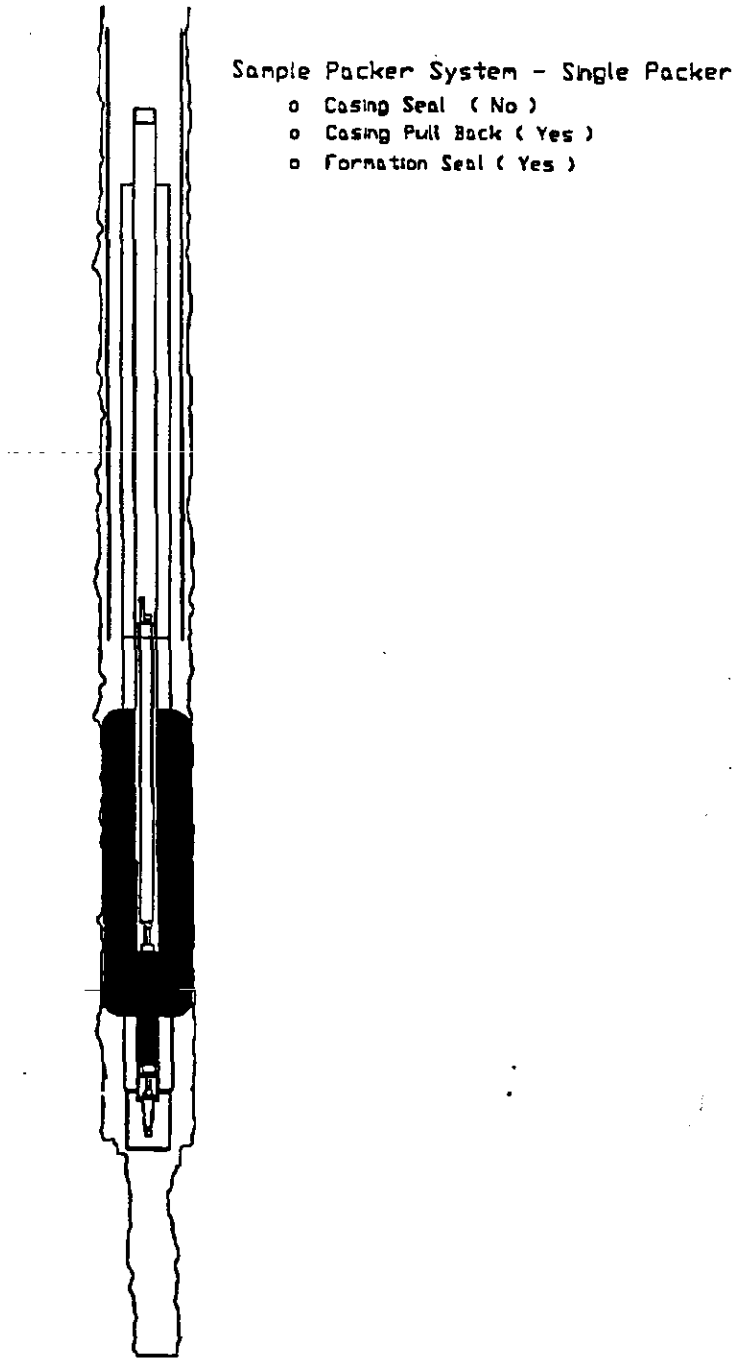


Figure 9. Section Line Relative to the Uranium and Technetium Water-Table Contaminant Plumes.

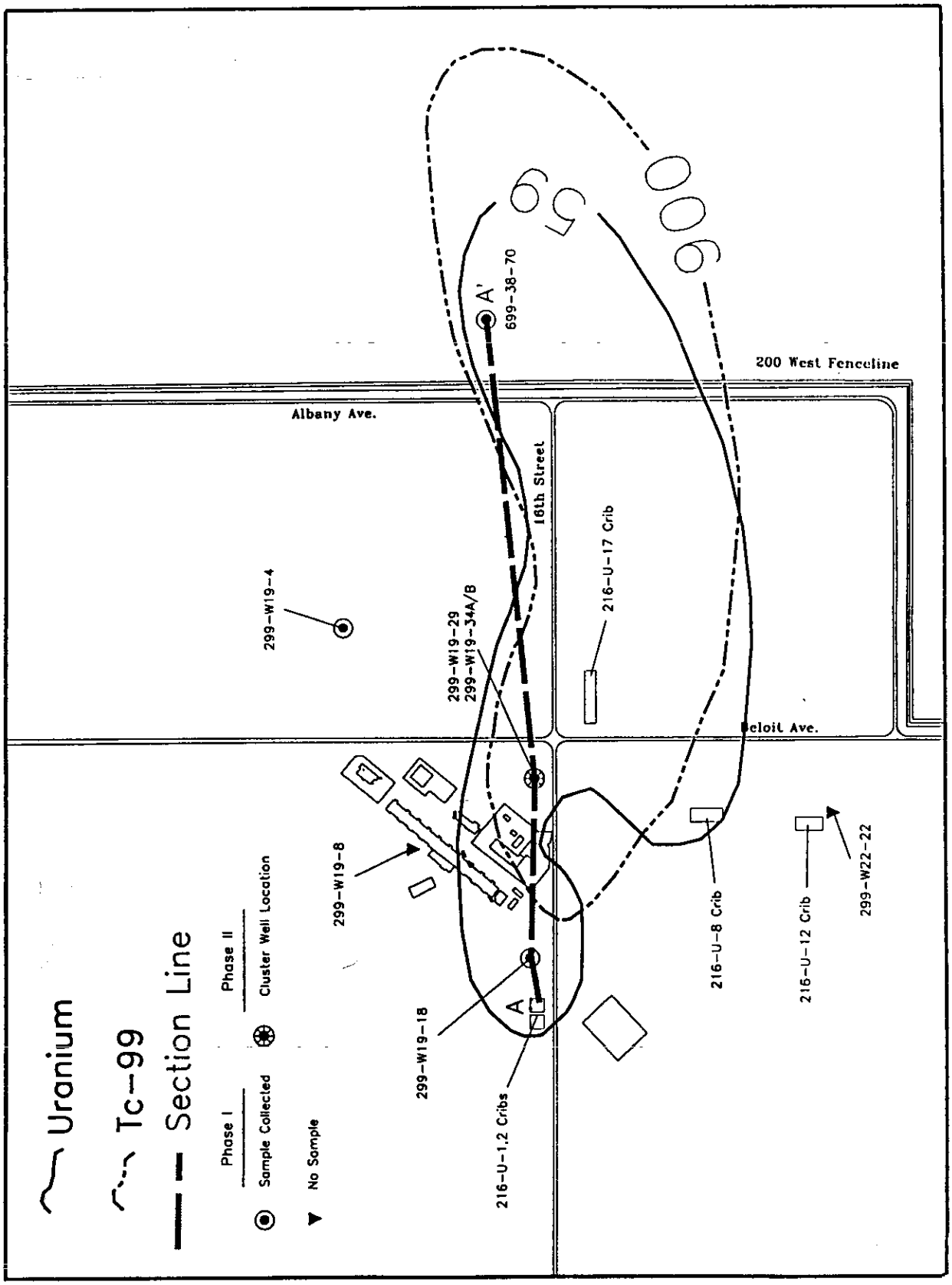


Figure 10. Section Line Relative to the Carbon Tetrachloride Water-Table Contaminant Plume.

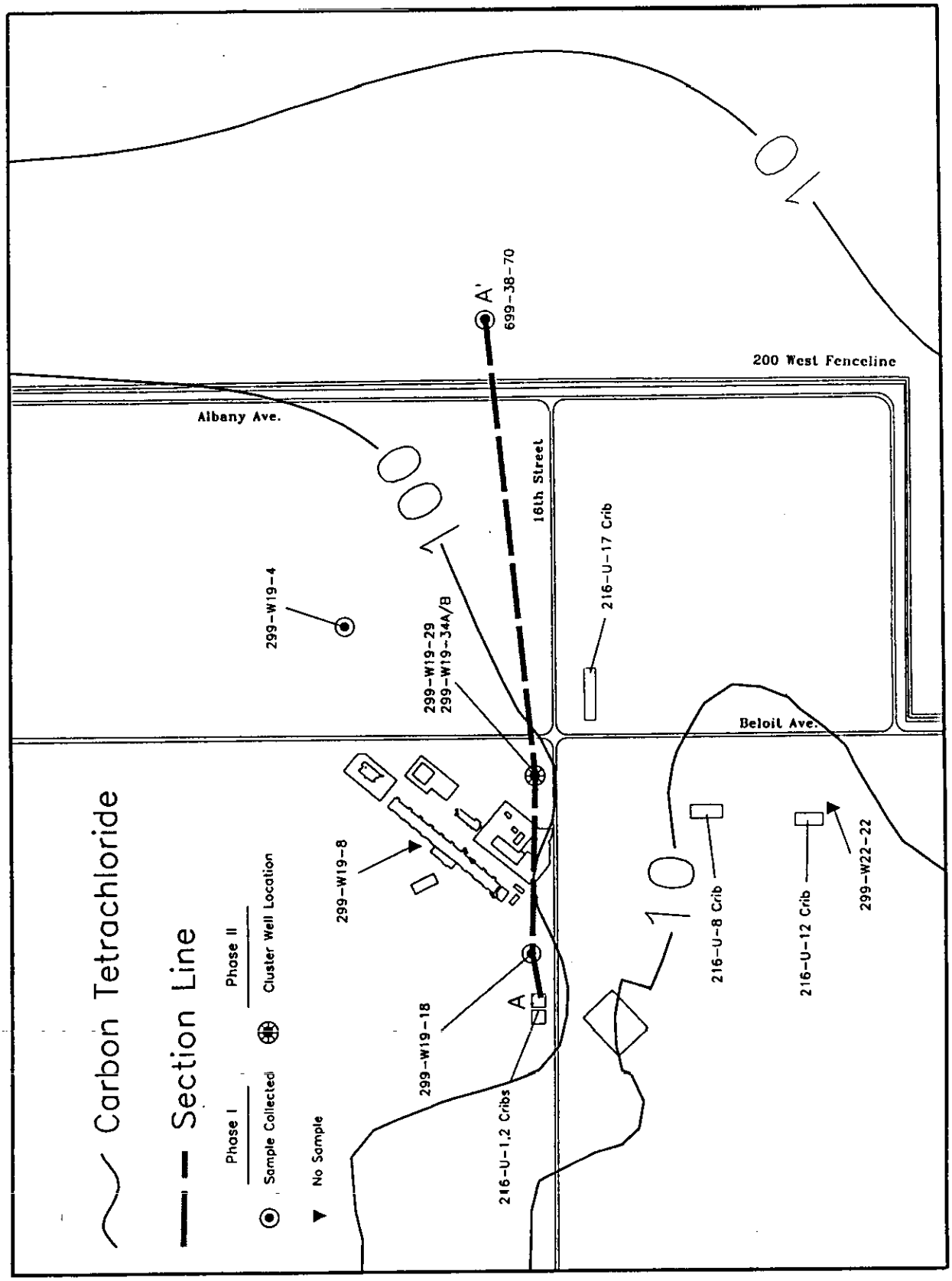


Figure 11. Vertical Distribution of pH Along Cross-Section A-A'.

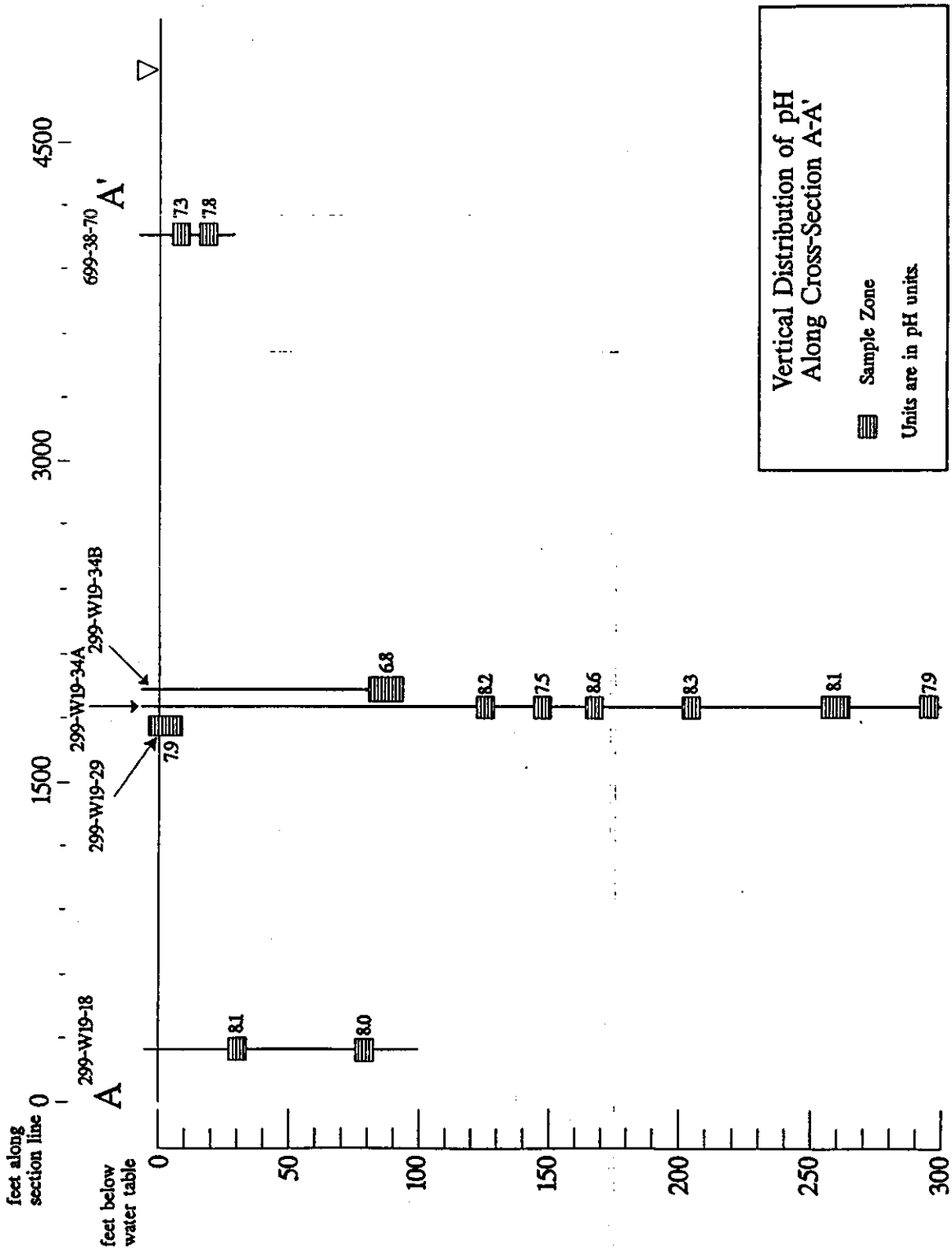


Figure 12. Vertical Distribution of Specific Conductance Along Cross-Section A-A'.

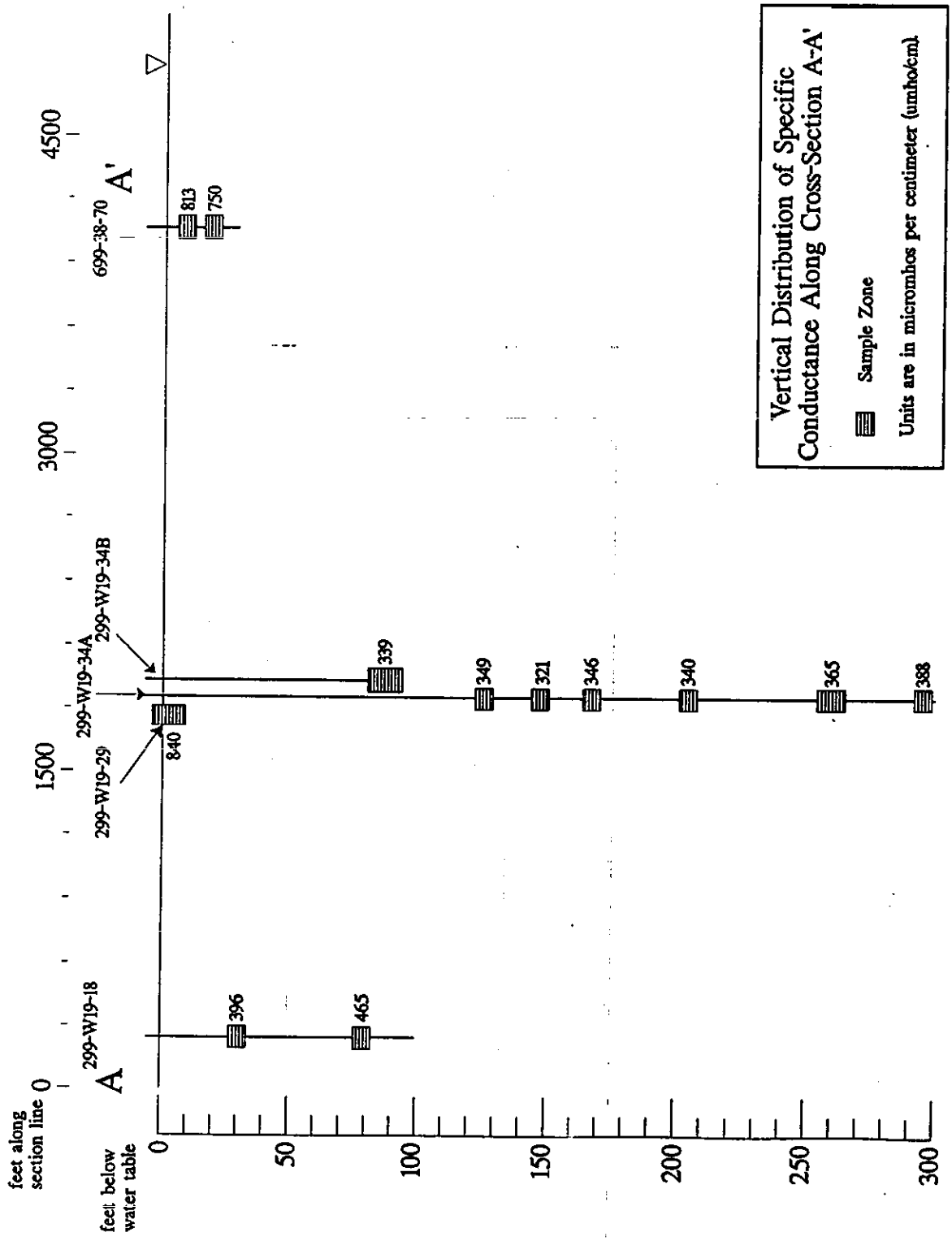


Figure 13. Vertical Distribution of Dissolved Oxygen Along Cross-Section A-A'.

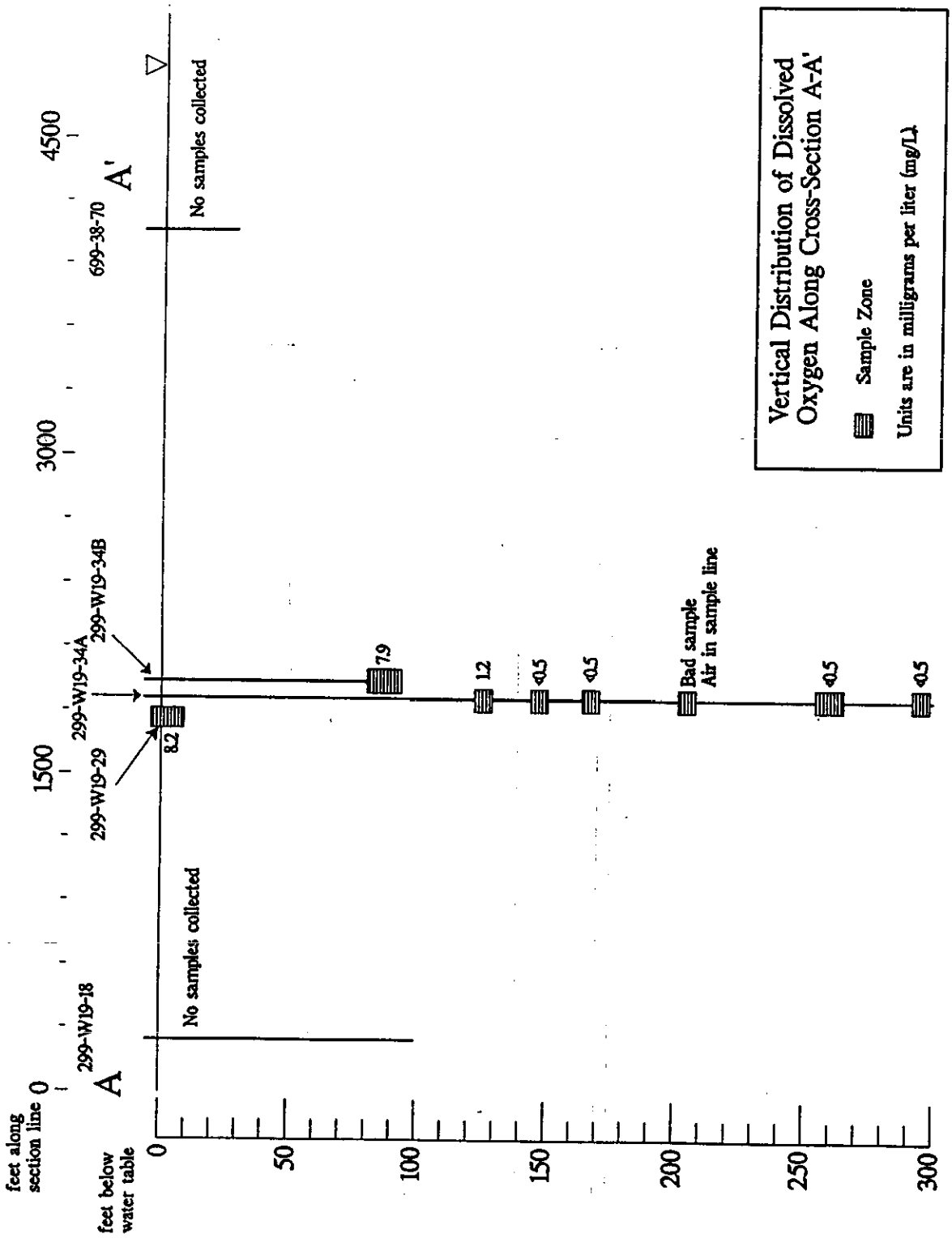


Figure 14. Vertical Distribution of Redox Potential Along Cross-Section A-A'.

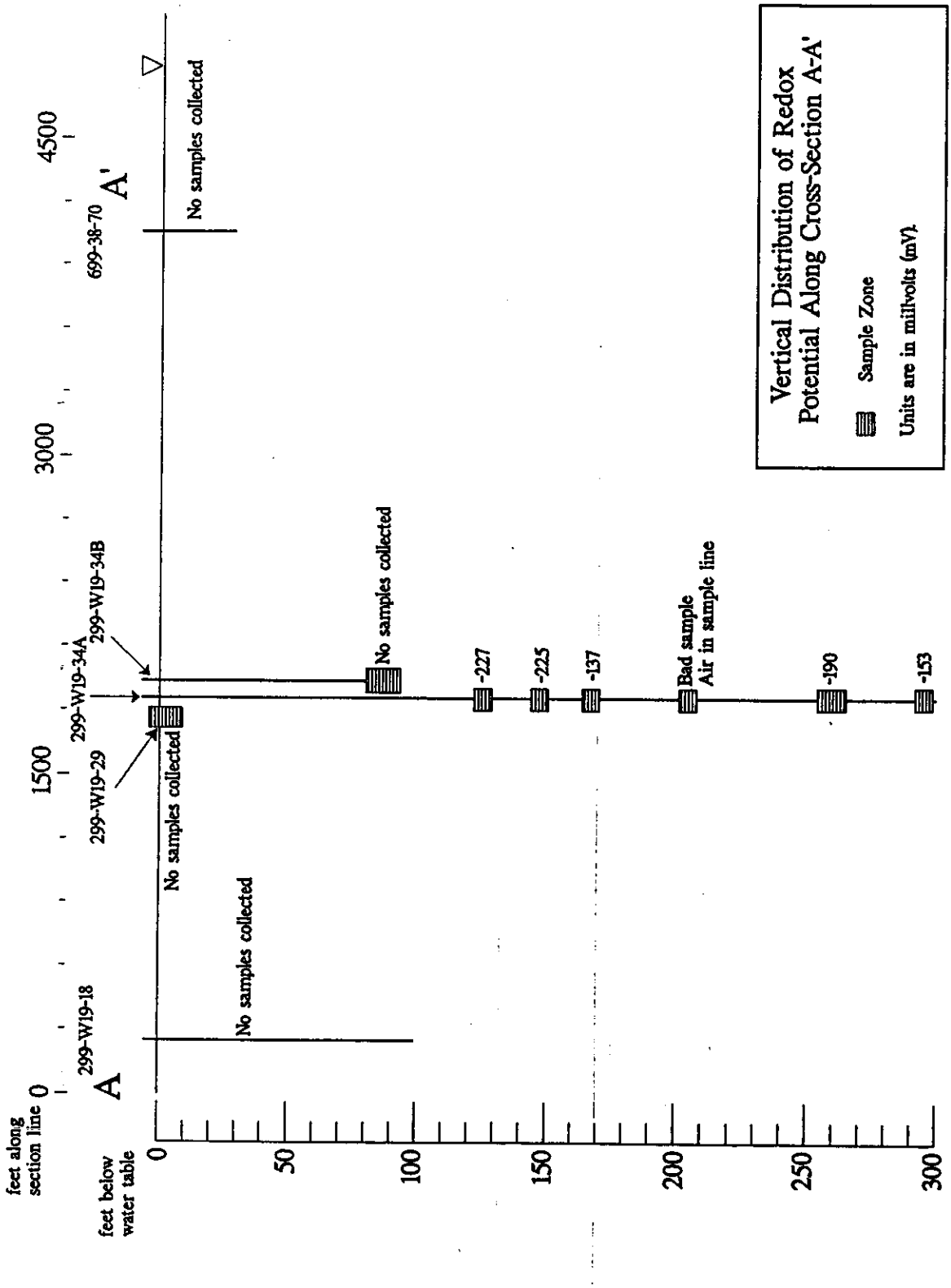


Figure 15. Vertical Distribution of Uranium Along Cross-Section A-A'.

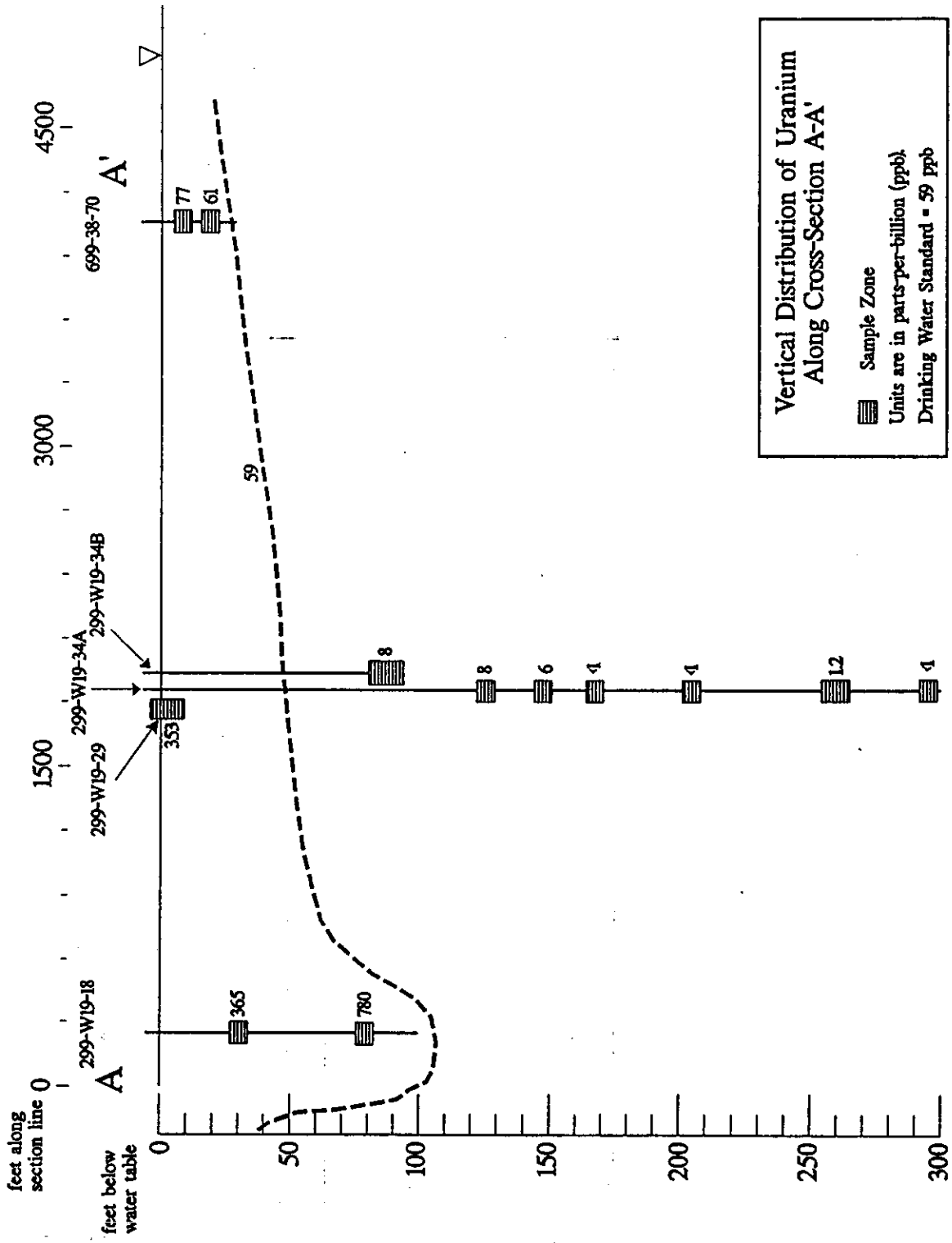


Figure 16. Vertical Distribution of Technetium-99 Along Cross-Section A-A'.

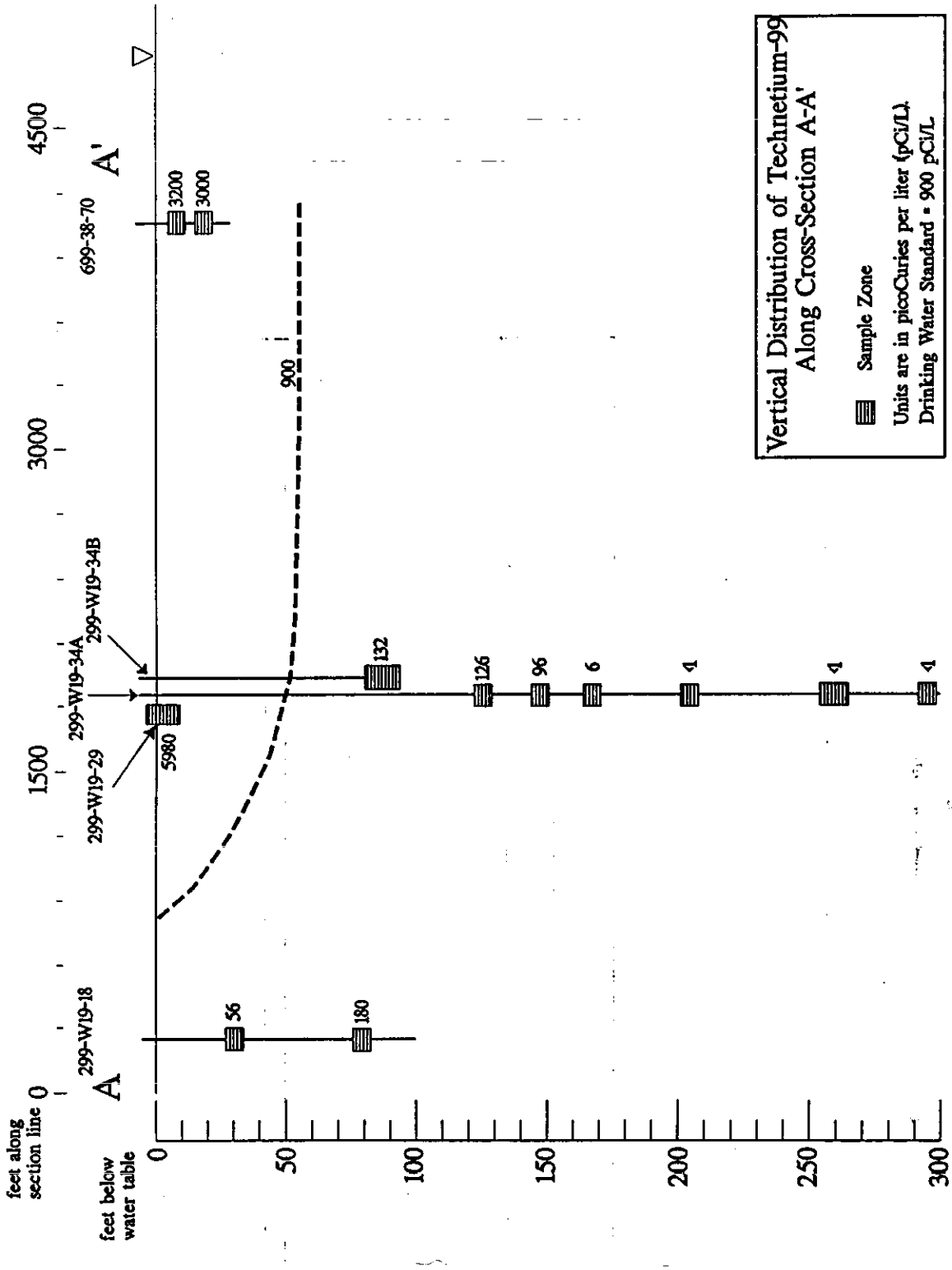


Figure 17. Vertical Distribution of Nitrate Along Cross-Section A-A'.

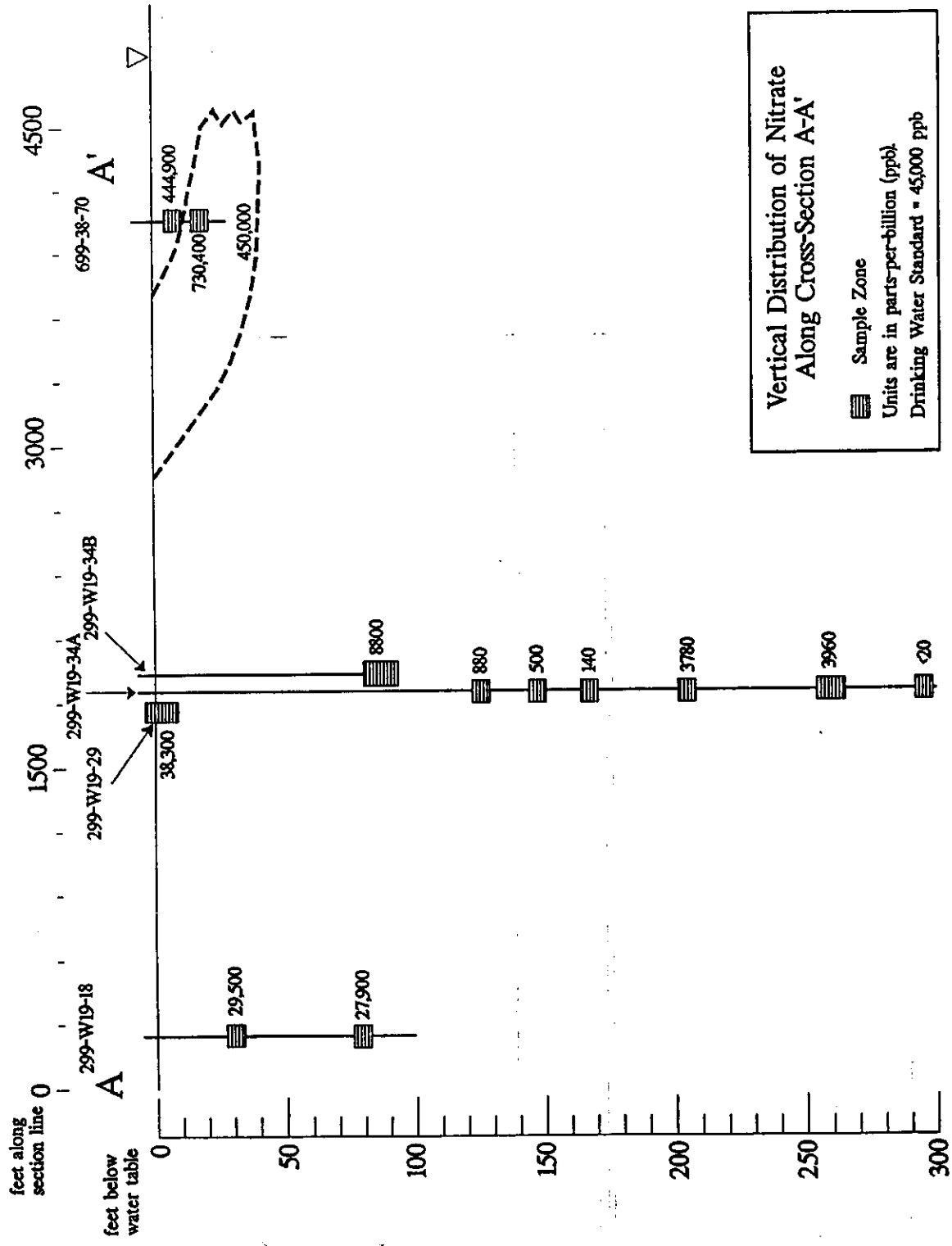
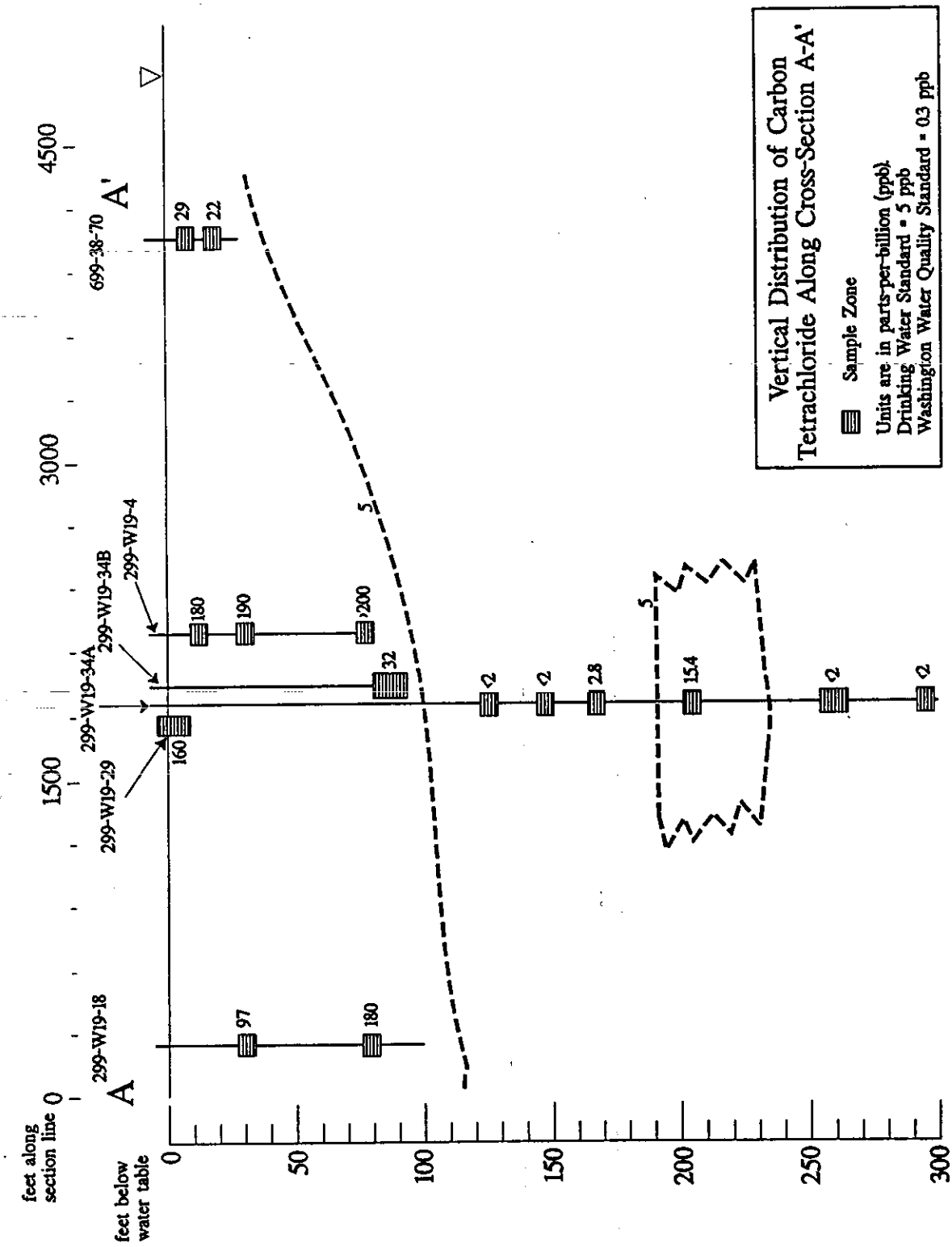


Figure 18. Vertical Distribution of Carbon Tetrachloride Along Cross-Section A-A'.



APPENDIX A

ANALYTICAL METHODS

Analytical Methodologies

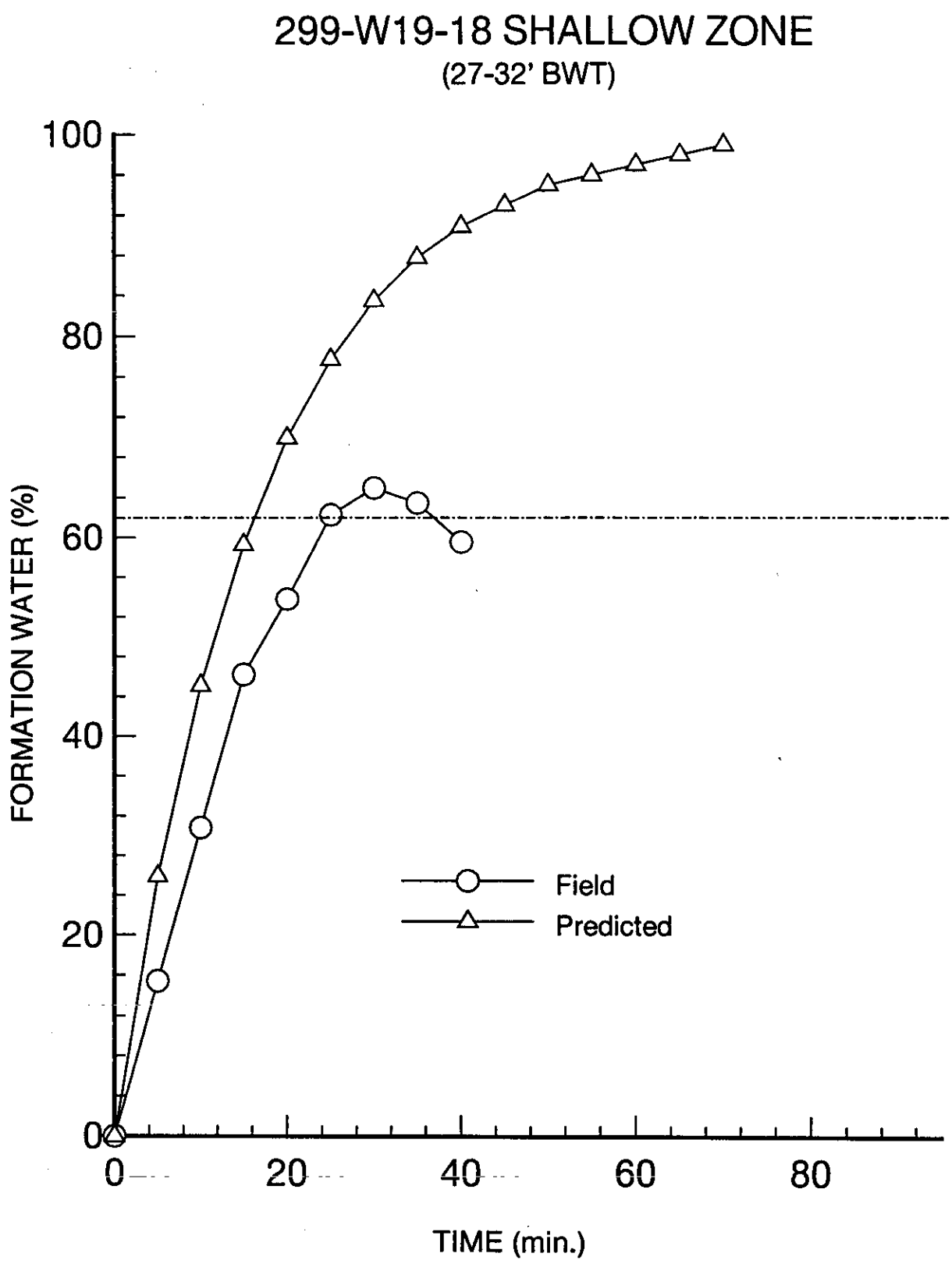
Analyte	Method	Holding Time	Bottle/Volume
Anions	EPA 300.2	28 Days	aG 250 mL
VOA	CLP	14 Days	aG 40 mL (3)
Radionuclides	Lab SOP	6 Months	P 2000 mL
•Tc-99			
•Total U			
Total Activity	Lab SOP	6 Months	G 250 mL
Field pH	HACH SOP	Immediate	P 50 mL
Field Conductivity	HACH SOP	Immediate	P 250 mL
Field VOA	Field SOP	14 Days	aG 40 mL
Field Nitrate	HACH 8039	14 Days	G 250 mL

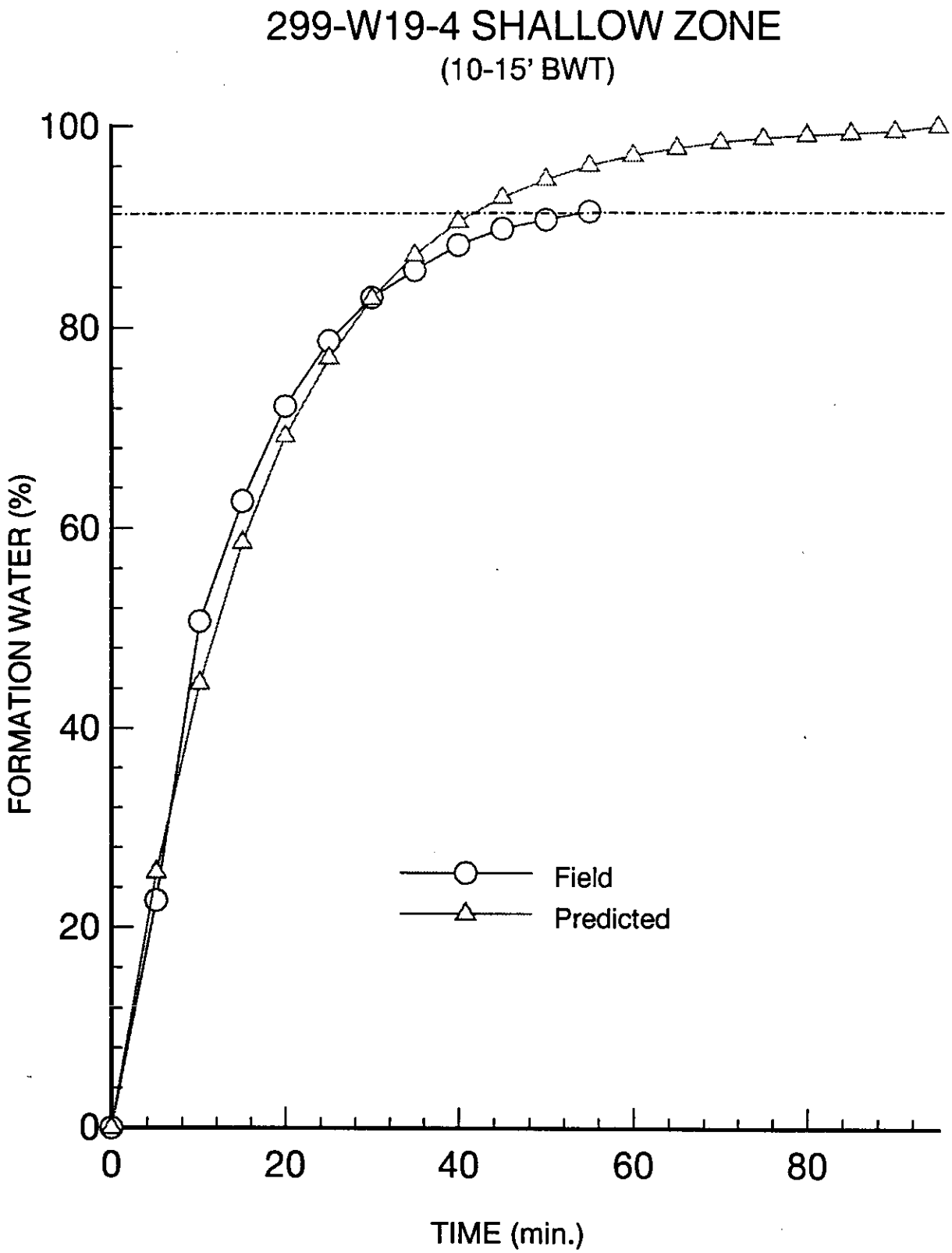
VOA = Volatile Organic Analysis
CLP = Contract Laboratory Program
SOP = Standard Operating Procedure

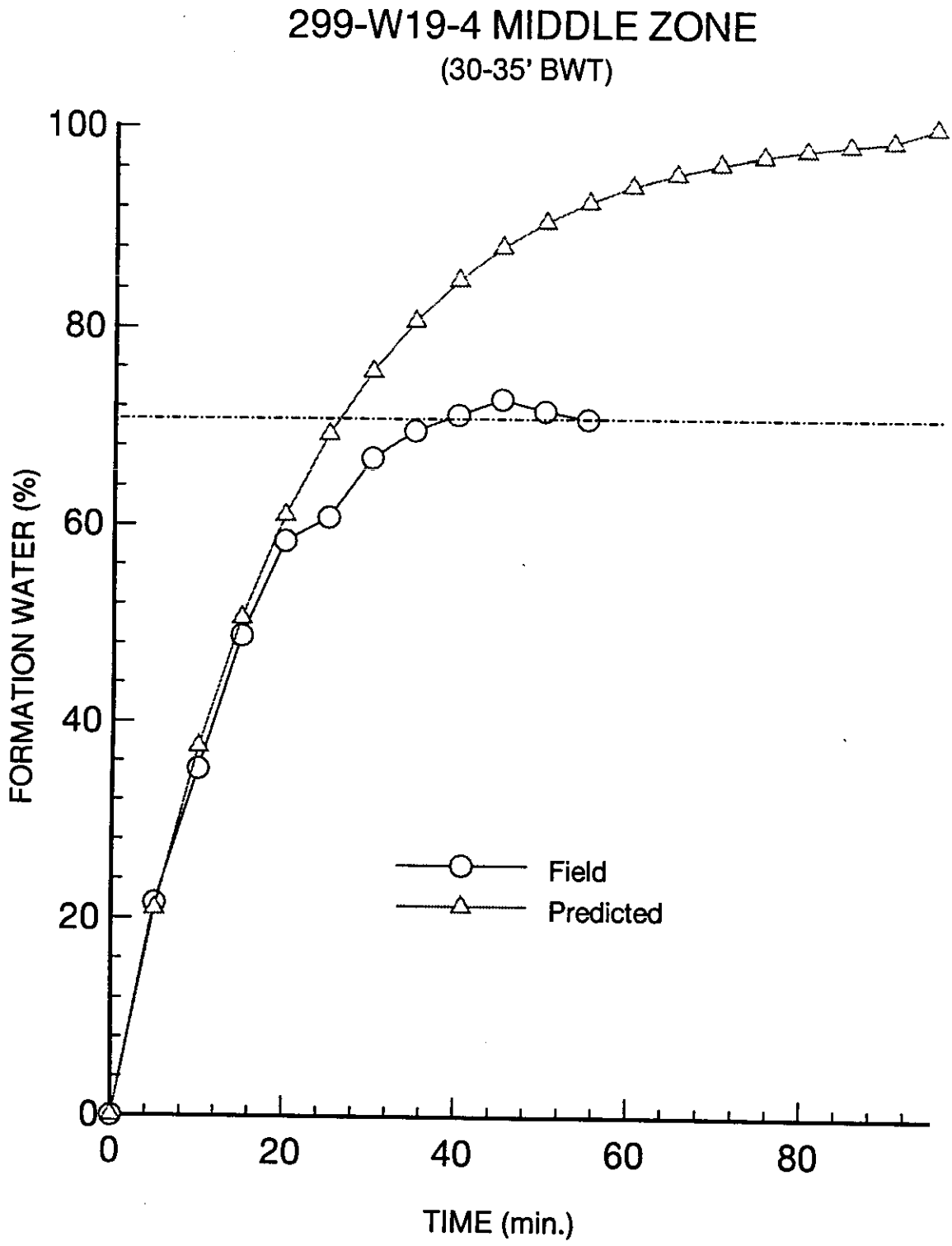
G = Glass
aG = Amber Glass
P = Plastic

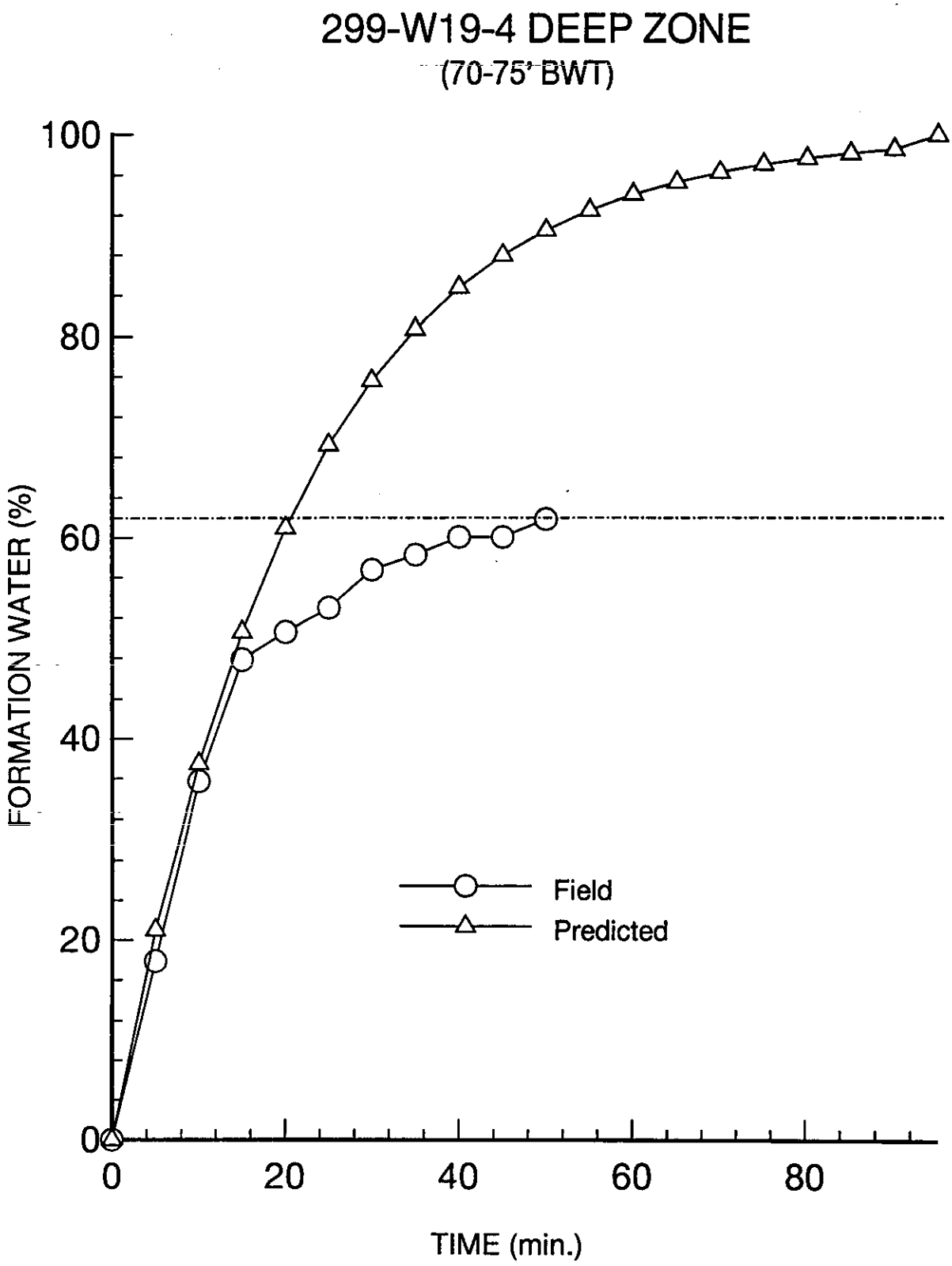
APPENDIX B

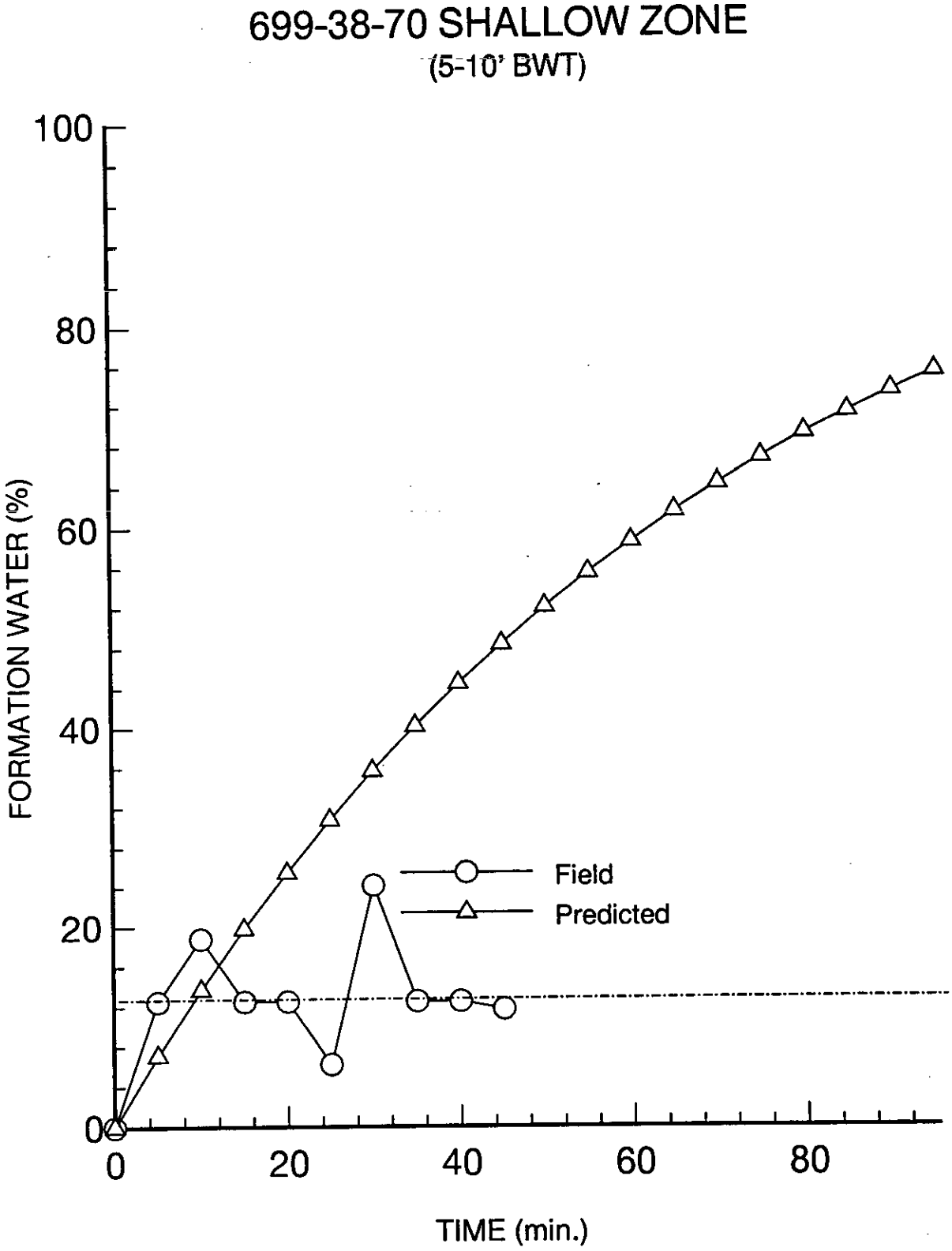
PHASE I TRACER RECOVERY CURVES

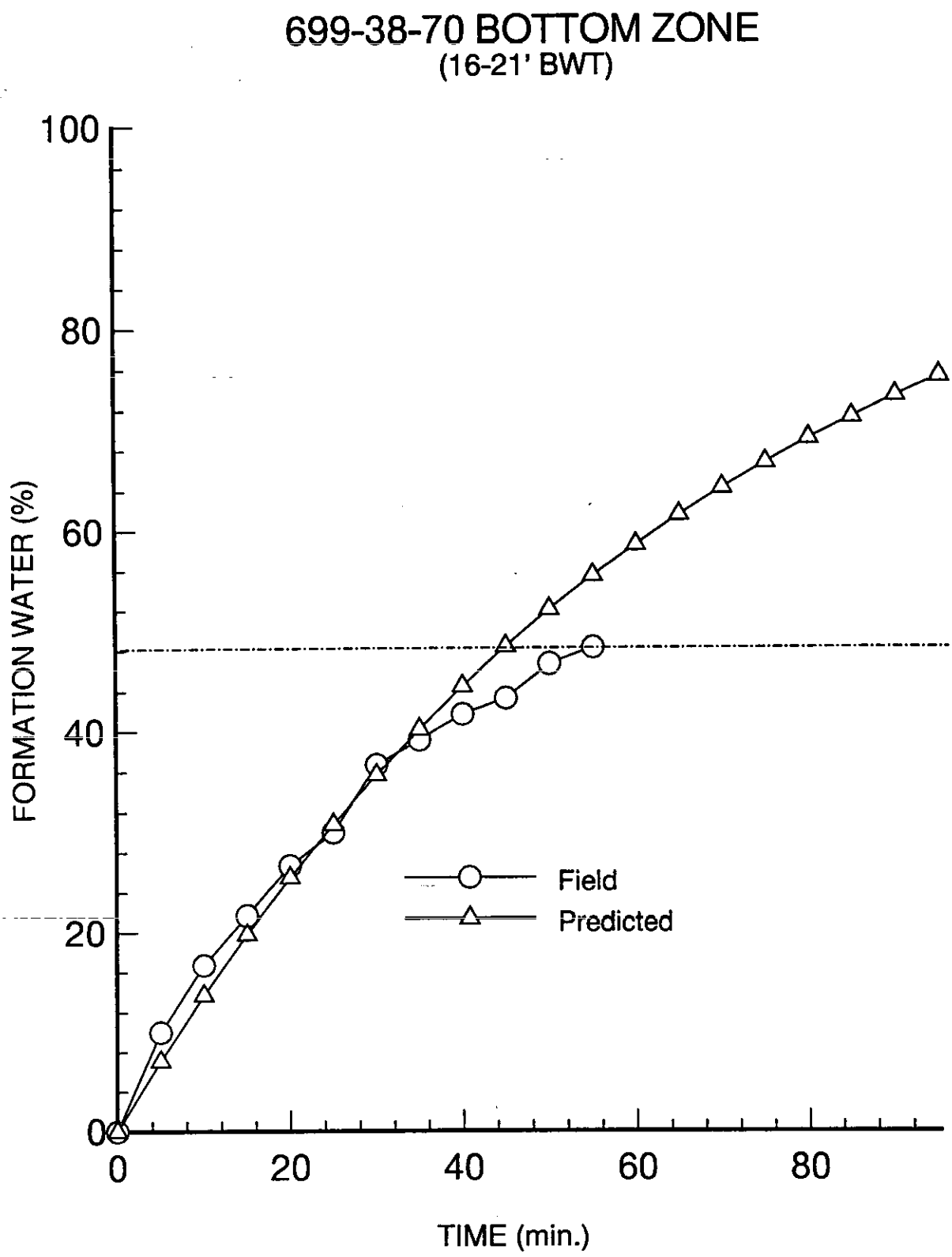

299-W19-18 SHALLOW ZONE
(27-32' BWT)
FORMATION WATER (%)
100
80
60
40
20
0
0
20
40
60
80
TIME (min.)
Field
Predicted


299-W19-4 SHALLOW ZONE
(10-15' BWT)
100
80
60
40
20
0
FORMATION WATER (%)
0
20
40
60
80
TIME (min.)
Field
Predicted


299-W19-4 MIDDLE ZONE
(30-35' BWT)
FORMATION WATER (%)
100
80
60
40
20
0
0
20
40
60
80
TIME (min.)
Field
Predicted


299-W19-4 DEEP ZONE
(70-75' BWT)
FORMATION WATER (%)
100
80
60
40
20
0
0
20
40
60
80
TIME (min.)
Field
Predicted


699-38-70 SHALLOW ZONE
(5-10' BWT)
100
80
60
40
20
0
FORMATION WATER (%)
0
20
40
60
80
TIME (min.)
Field
Predicted


699-38-70 BOTTOM ZONE
(16-21' BWT)
FORMATION WATER (%)
100
80
60
40
20
0
0
20
40
60
80
TIME (min.)
Field
Predicted

APPENDIX C

ANALYTICAL RESULTS

200-UP-1 DRILL AND TEST GROUNDWATER RESULTS

Well	Depth (ft. BWT)	Date	Constituent	Result	Units	Lab/Field
299-W19-18	27-32	12/30/93	pH	8.1	pH units	Field
299-W19-18	27-32	12/30/93	Specific conductance	396.0	umhos/cm	Field
299-W19-18	27-32	12/30/93	Dissolved oxygen	NA	mg/l	Field
299-W19-18	27-32	12/30/93	Eh	NA	mV	Field
299-W19-18	27-32	12/30/93	Uranium	365.0	ppb	Lab
299-W19-18	27-32	12/30/93	Technetium-99	56.0	pCi/l	Lab
299-W19-18	27-32	12/30/93	Nitrate	29500.0	ppb	Lab
299-W19-18	27-32	12/30/93	Carbon tetrachloride	97.0	ppb	Lab
299-W19-18	76-81	12/30/93	pH	8.0	pH units	Field
299-W19-18	76-81	12/30/93	Specific conductance	465.0	umhos/cm	Field
299-W19-18	76-81	12/30/93	Dissolved oxygen	NA	mg/l	Field
299-W19-18	76-81	12/30/93	Eh	NA	mV	Field
299-W19-18	76-81	12/30/93	Uranium	780.0	ppb	Lab
299-W19-18	76-81	12/30/93	Technetium-99	180.0	pCi/l	Lab
299-W19-18	76-81	12/30/93	Nitrate	27900.0	ppb	Lab
299-W19-18	76-81	12/30/93	Carbon tetrachloride	180.0	ppb	Lab
299-W19-4	10-15	9/2/93	Carbon tetrachloride	180.0	ppb	Lab
299-W19-4	30-35	9/2/93	Carbon tetrachloride	190.0	ppb	Lab
299-W19-4	70-75	9/2/93	Carbon tetrachloride	>200	ppb	Lab
699-38-70	5-10	8/26/93	pH	7.3	pH units	Field
699-38-70	5-10	8/26/93	Specific conductance	813.0	umhos/cm	Field
699-38-70	5-10	8/26/93	Dissolved oxygen	NA	mg/l	
699-38-70	5-10	8/26/93	Eh	NA	mV	
699-38-70	5-10	8/26/93	Uranium	77.0	ppb	Lab
699-38-70	5-10	8/26/93	Technetium-99	3200.0	pCi/l	Lab
699-38-70	5-10	8/26/93	Nitrate	444900.0	ppb	Lab
699-38-70	5-10	8/26/93	Carbon tetrachloride	29.0	ppb	Lab
699-38-70	16-21	8/26/93	pH	7.8	pH units	Field
699-38-70	16-21	8/26/93	Specific conductance	750.0	umhos/cm	Field
699-38-70	16-21	8/26/93	Dissolved oxygen	NA	mg/l	
699-38-70	16-21	8/26/93	Eh	NA	mV	
699-38-70	16-21	8/26/93	Uranium	61.0	ppb	Lab
699-38-70	16-21	8/26/93	Technetium-99	3000.0	pCi/l	Lab
699-38-70	16-21	8/26/93	Nitrate	730400.0	ppb	Lab
699-38-70	16-21	8/26/93	Carbon tetrachloride	22.0	ppb	Lab
299-W19-29	0-12	2/17/94	pH	7.9	pH units	Field
299-W19-29	0-12	2/17/94	Specific conductance	840.0	umhos/cm	Field
299-W19-29	0-12	6/17/94	Dissolved oxygen	8.2	mg/l	Field
299-W19-29	0-12	6/17/94	Eh	NA	mV	Field
299-W19-29	0-12	2/17/94	Uranium	353.0	ppb	Lab
299-W19-29	0-12	2/17/94	Technetium-99	5980.0	pCi/l	Lab
299-W19-29	0-12	2/17/94	Nitrate	38300.0	ppb	Lab
299-W19-29	0-12	2/17/94	Carbon tetrachloride	160.0	ppb	Lab
299-W19-34A	81-97	6/17/94	pH	6.8	pH units	Field
299-W19-34A	81-97	6/17/94	Specific conductance	339.0	umhos/cm	Field

200-UP-1 DRILL AND TEST GROUNDWATER RESULTS

299-W19-34A	81-97	6/17/94	Dissolved oxygen	7.9	mg/l	Field
299-W19-34A	81-97	6/17/94	Eh	NA	mV	
299-W19-34A	81-97	6/17/94	Uranium	8.0	ppb	Lab
299-W19-34A	81-97	6/17/94	Technetium-99	132.0	pCi/l	Lab
299-W19-34A	81-97	6/17/94	Nitrate	8800.0	ppb	Field
299-W19-34A	81-97	6/17/94	Carbon tetrachloride	32.0	ppb	Field
299-W19-34B	123-128	6/17/94	pH	8.2	pH units	Field
299-W19-34B	123-128	6/17/94	Specific conductance	349.0	umhos/cm	Field
299-W19-34B	123-128	6/17/94	Dissolved oxygen	1.2	mg/l	Field
299-W19-34B	123-128	6/17/94	Eh	-227.0	mV	Field
299-W19-34B	123-128	6/17/94	Uranium	8.0	ppb	Lab
299-W19-34B	123-128	6/17/94	Technetium-99	126.0	pCi/l	Lab
299-W19-34B	123-128	6/17/94	Nitrate	880.0	ppb	Field
299-W19-34B	123-128	6/17/94	Carbon tetrachloride	<2	ppb	Field
299-W19-34B	145-148	6/27/94	pH	7.5	pH units	Field
299-W19-34B	145-148	6/27/94	Specific conductance	321.0	umhos/cm	Field
299-W19-34B	145-148	6/27/94	Dissolved oxygen	<0.5	mg/l	Field
299-W19-34B	145-148	6/27/94	Eh	-225.0	mV	Field
299-W19-34B	145-148	6/27/94	Uranium	6.0	ppb	Lab
299-W19-34B	145-148	6/27/94	Technetium-99	96.0	pCi/l	Lab
299-W19-34B	145-148	6/27/94	Nitrate	500.0	ppb	Field
299-W19-34B	145-148	6/27/94	Carbon tetrachloride	<2	ppb	Field
299-W19-34B	168-173	7/13/94	pH	8.6	pH units	Field
299-W19-34B	168-173	7/13/94	Specific conductance	346.0	umhos/cm	Field
299-W19-34B	168-173	7/13/94	Dissolved oxygen	<0.5	mg/l	Field
299-W19-34B	168-173	7/13/94	Eh	-137.0	mV	Field
299-W19-34B	168-173	7/13/94	Uranium	0.2	ppb	Lab
299-W19-34B	168-173	7/13/94	Technetium-99	6.0	pCi/l	Lab
299-W19-34B	168-173	7/13/94	Nitrate	140.0	ppb	Lab
299-W19-34B	168-173	7/13/94	Carbon tetrachloride	2.8	ppb	Lab
299-W19-34B	206-210	8/5/94	pH	8.3	pH units	Field
299-W19-34B	206-210	8/5/94	Specific conductance	340.0	umhos/cm	Field
299-W19-34B	206-210	8/5/94	Dissolved oxygen	NA	mg/l	
299-W19-34B	206-210	8/5/94	Eh	NA	mV	Field
299-W19-34B	206-210	8/5/94	Uranium	0.2	ppb	Lab
299-W19-34B	206-210	8/5/94	Technetium-99	<1	pCi/l	Lab
299-W19-34B	206-210	8/5/94	Nitrate	3780.0	ppb	Lab
299-W19-34B	206-210	8/5/94	Carbon tetrachloride	15.4	ppb	Field
299-W19-34B	254-264	8/22/94	pH	8.1	pH units	Field
299-W19-34B	254-264	8/22/94	Specific conductance	365.0	umhos/cm	Field
299-W19-34B	254-264	8/22/94	Dissolved oxygen	<0.5	mg/l	Field
299-W19-34B	254-264	8/22/94	Eh	-190.0	mV	Field
299-W19-34B	254-264	8/22/94	Uranium	1.2	ppb	Lab
299-W19-34B	254-264	8/22/94	Technetium-99	<1	pCi/l	Lab
299-W19-34B	254-264	8/22/94	Nitrate	3960.0	ppb	Field
299-W19-34B	254-264	8/22/94	Carbon tetrachloride	<2	ppb	Field

200-UP-1 DRILL AND TEST GROUNDWATER RESULTS

299-W19-34B	293-299	9/12/94	pH	7.9	pH units	Field
299-W19-34B	293-299	9/12/94	Specific conductance	388.0	umhos/cm	Field
299-W19-34B	293-299	9/12/94	Dissolved oxygen	<0.5	mg/l	Field
299-W19-34B	293-299	9/12/94	Eh	-153.0	mV	Field
299-W19-34B	293-299	9/12/94	Uranium	<0.2	ppb	Lab
299-W19-34B	293-299	9/12/94	Technetium-99	<1	pCi/l	Lab
299-W19-34B	293-299	9/12/94	Nitrate	<20	ppb	Lab
299-W19-34B	293-299	9/12/94	Carbon tetrachloride	<2	ppb	Lab

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